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Program updates and changes may be found on the Conference Program Update Sheet distributed in the registration bags.

Conference Schedule-at-a-Glance

	Sunday 18 October	Monday 19 October	Tuesday 20 October	Wednesday 21 October	Thursday 22 October
GENERAL & EXHIBITS			•		·
Registration	12:00-18:30	07:00 - 18:00	07:00-18:00	07:00-18:00	07:30-17:30
Speaker Ready Room	12:00-18:00	07:00-18:00	07:00-18:00	07:00-18:00	07:30-15:30
Coffee Breaks		10:00-10:30	09:30-10:00	09:30-10:00	10:00-10:30
		15:30–16:00	14:30-15:00	15:30-16:00	15:00-15:30
Exhibition			09:30-16:00	09:30-14:00	
Unopposed Exhibition-only Times			09:30-10:30	09:30-11:00	
			12:00–13:00 14:30–16:00	12:30–13:30	
PROGRAMMING				1	1
Townes Memorial Symposium: Reminiscences – Scientific and Personal	16:30–18:30				
FiO/LS Technical Sessions		08:00-15:30	10:30-18:00	11:00-18:00	08:00-17:30
Symposium on Photoreceptor Analysis and Single-cone-mediated Vision		08:00-10:00			
Laser Science Symposium on Undergraduate Research		10:00 - 16:00			
Symposium on Optics for Global Health and Low Resource Settings		13:30–15:30			
IYL – Science to Solutions		16:00–18:00			
Joint FiO/LS Plenary & Awards Sessions			08:00-09:30	08:00-09:30	
Joint FiO/LS Poster Sessions			14:30-16:00	09:30-11:00	
Symposium Honoring Adolf Lohmann				11:00-18:15	
Symposium on Optical Remote Sensing for the Climate				13:30–15:00	
FiO Postdeadline Paper Sessions				20:00-22:00	
Symposium on Applications of Low Noise Frequency Combs					13:00–17:30
SPECIAL EVENTS					
OSA Student Chapter Leadership Meeting (Invitation only)	07:00-17:00				
Townes Memorial Reception (sponsored by Thorlabs)	18:30-20:00				
OSA Student Member Reception	19:00-22:00				
Frontiers in Photonic Detection Panel Discussion		12:00–13:30			
Nonlinear Optics Technical Group Workshop		12:00-13:30			
OSA Fellow Members Lunch (invitation only)		12:00-13:30			
Meet OSA's Journal Editors		18:00–19:00			
OSA Microscopy and Optical Coherence Tomography Technical Group Poster Session		18:00–19:00			
International Year of Light/OSA President's Reception		18:30-20:30			
Optical Material Studies Technical Group			12:00-13:30		
Better than Fakin' it Good: Multifunctional Bioreplication			12:00–13:30		
OSA Student Chapter Competition			14:30-16:00		
Minorities and Women in OSA (MWOSA) Networking Reception			16:00–17:00		
Exhibitor Appreciation Reception (Sponsored by OSA Industry Development Association)			16:00-17:00		
OSA Annual Business Meeting			17:00–17:45		
DLS Annual Business Meeting			17:00-18:00		
OSA Member Reception			18:30-20:30		
Laser Science Banquet			19:00-22:00		
VIP Industry Leaders Networking Event				12:30–14:00	
Meet the Editors of the APS Journals				13:00–14:30	
OSA Science Educators' Day				17:00-20:00	
Optical Fabrication and Testing Technical Group Networking Event				18:00-20:00	
OIDA Town Hall Forum on Biophotonics Challenges and Opportunities				18:00-20:00	

Note: Dates and Times are subject to change. All times reflect Pacific time zone.

Welcome to Frontiers in Optics 2015

Welcome to San Jose, California—one of the premier centers of optics and photonics research in the USA. We are pleased that you have chosen to join us for the 2015 Frontiers in Optics (FiO) conference, the 99th Annual Meeting of The Optical Society.

This year's conference encompasses the breadth of optical science and engineering and provides an atmosphere that fosters the exchange of information between those working on fundamental research and those looking for solutions to engineering problems. On behalf of the FiO Subcommittee Chairs, we would like to thank our colleagues from the Division of Laser Science (DLS) of the American Physical Society (APS) for assisting in cultivating joint topics and sessions that will greatly enhance the experience of the attendees at FiO 2015.

The technical program features over 700 invited, contributed oral and poster presentations by celebrated members of the community describing some of the most exciting advances in their fields. Special symposia and other major events further highlight major advances in many selected areas.

Joss Bland-Hawthorne, University of Sydney, Australia, the FiO plenary speaker, will speak on Astrophotonics: Future Developments in Astrophysics and Instrumentation at the Wednesday Plenary Session. James G. Fujimoto, MIT, USA, winner of the OSA 2015 Frederic Ives Medal/Jarus W. Quinn Prize, will also give an address at the Tuesday Plenary session. They will be joined by the LS plenary speaker David Reitze and the recipient of the APS 2015 Arthur L. Schawlow Prize in Laser Science, Christopher Monroe.

FiO is pleased to feature several special symposia – The Townes Symposium: Reminiscences – Scientific and Personal (Sunday, 18 October, 16:30–18:30); the Symposium on Photore-ceptor Analysis and Single-cone-mediated Vision (Monday, 19 October, 08:00–10:00); the Symposium on Optics for Global Health and Low Resource Settings (Monday, 19 October, 13:30–15:00); the Symposium on Optical Remote Sensing for the Climate (Wednesday, 21 October, 13;30–15:30); and the Symposium on Applications of Low Noise Frequency Combs (Thursday, 22 October, 13:00–17:30). Details about all the symposia are listed on the Symposia pages of this program.

This year's meeting is filled with many informational and networking events. Some of the highlights of FiO 2015 include the following:

- The Townes Memorial Symposium will be immediately followed by a reception on Sunday, 19 October, from 18:30–20:00.
- OSA Students will be welcomed at the OSA Student Member reception on Sunday, 19 October from 19:00–22:00.
- The International Year of Light Science to Solutions Special Session will be held on Monday, 19 October, 16:00–18:00 followed by the International Year of Light/OSA Presidents Reception from 18:30–20:30.
- If you are an OSA member, be sure to join us at the OSA Member Reception on Tuesday, 20 October, from 18:30–20:30.
- Late-breaking advances in optics will be presented on Wednesday, 21 October, in the FiO Postdeadline Paper Sessions, running from 20:00–22:00.

- FiO is pleased to announce the 7th annual Emil Wolf Outstanding Student Paper Competition. One award winner will be selected from each of the seven FiO subcommittees. Selections will be made based on the quality of the submitted technical summary and presentation. Winners will be announced at the end of the conference and in the next issue of *Optics & Photonics News* (OPN).
- Tuesday and Wednesday, while you are enjoying the poster sessions and the coffee breaks in the Exhibit Hall and/or taking breaks from the presentations, please see the latest in scientific and optical instrumentation and information that our exhibitors have on display!
- Science Educators' Day will be held on Wednesday, 22 October, from 17:00–20:00, in the Regency Ballroom I. Hosted by The Optical Society, Science Educator's Day (EDAY) provides middle and high school science teachers with a wide variety of optics-focused lesson plans and classroom demonstration guides. EDAY attendees receive materials that can be used in middle and high school classrooms.

We welcome you to FiO 2015 and encourage you to take full advantage of the benefits of this year's social and networking opportunities, technical sessions, corporate programming, poster sessions and exhibition!





David Hagan General Chair Univ. of Central Florida, CREOL, USA



Nozomi Nishimura Program Chair Cornell Univ., USA

Nikola Alic General Chair Univ. of California at San Diego, USA



Ronald Reano Program Chair Ohio State Univ., USA

Welcome to Laser Science 2015

The leadership of the Division of Laser Science (DLS) of the American Physical Society (APS) is pleased to welcome you to our 31st annual meeting, Laser Science (LS) 2015, in San Jose, California, 18–22 October 2015. We are grateful for the help of our colleagues and technical program committee members, Ido Kaminer, Josh Hendrickson, Sangam Chatterjee, Nasser Peyghambarian, Lei Tian, Jesse Wilson, Dylan Yost, and Jeff Field, in organizing a broad range of topics in physics, biology and chemistry.

This year's program includes many of the areas at the forefront of laser science that are customarily found at the annual DLS meeting, as well as a tutorial by Eli Yablonovitch on "Can Opto-Electronics Provide the Motive Power for Future Vehicles?" We have collaborated with our colleagues in The Optical Society to coordinate schedules to encourage your intellectual wanderings between DLS and OSA sessions.

In addition to an outstanding technical program, there are many exciting special symposia and events scheduled for the meeting this year. Special attention is appropriate for the Symposium on Undergraduate Research on Monday, which showcases the work of some of our youngest scientists. The Symposium will feature a special poster session to present the work of selected undergraduate researchers.

David Reitze, *California Inst. of Technology, USA*, the LS plenary speaker, will speak on LIGO and the Coming Dawn of Gravitational Wave Physics and Astronomy at the Plenary Session and Awards Ceremony, Tuesday, 20 October from 08:00–09:30. Christopher Monroe, *University of Maryland, USA*, winner of the APS 2015 Arthur L. Schawlow Prize in Laser Science, will give his address on Wednesday, 21 October. They will be joined by the FiO plenary speaker and the recipient of the OSA 2015 Frederic Ives Medal/Jarus W. Quinn Prize. The technical sessions for the Laser Science meeting are organized around several broad themes: Accelerating Beams in Optics and Beyond; Innovative Metallic-Emitter Coupled Systems; Semiconductor Nanooptics; Novel Fiber Lasers; Computational Optical Imaging; Advances in Nonlinear Laser Spectroscopy; and Light Propagation in Scattering Media. Also of special note is an International Year of Light – Science to Solutions Special Session (Monday, 19 October, 16:00–18:00).

Our DLS business meeting will be held Tuesday, 20 October from 17:00 to 18:00 in the Belvedere Room. The Laser Science banquet will be Tuesday evening, following the business meeting at the Gordon Biersch restaurant from 19:00–22:00.

We welcome you to the Laser Science 2015 Meeting and encourage you to take full advantage of this year's technical and poster sessions, symposia, and plenary lectures, as well as an exhibit hall showcasing leading suppliers to the laser science community.

Enjoy!



Galina Khitrova Conference General Chair Univ. of Arizona, USA



Randy Bartels Conference Program Chair Univ. of California Davis, USA

General Information

Conference Services

Registration

Market Street Foyer

Registration Hours

Sunday, 18 October	12:00–18:30
Monday, 19 October	07:00-18:00
Tuesday, 20 October	07:00–18:00
Wednesday, 21 October	07:00–18:00
Thursday, 22 October	07:30–17:30

Speaker Preparation Room

Paseo

Speakers and presenters are encouraged to stop by the Speaker Preparation Room to test their computers and presentations prior to their session. The room will be equipped with LCD projectors and screens. Computers will be available to test presentations.

Speaker Preparation Hours

Sunday, 18 October	12:00–18:00
Monday, 19 October	07:00–18:00
Tuesday, 20 October	07:00–18:00
Wednesday, 21 October	07:00–18:00
Thursday, 22 October	07:30–15:30

Media Room

Redwood

A staffed media room is available for credentialed members of the media. Badges for pre-registered reporters and reporter registration are in the media room along with press kits, internet connectivity and printer, quiet work space and conference information.

Media Room Hours

Sunday, 18 October	12:00-16:00
Monday, 19 October	07:30–18:00
Tuesday, 20 October	07:30–18:00
Wednesday, 21 October	07:30–18:00
Thursday, 22 October	07:30–12:00

E-Center

Market Street Foyer

The E-Center, offering free internet connectivity, will be open Sunday through Thursday during registration hours.

Exhibition

Tuesday, 20 October, 09:30–16:00 and Wednesday, 21 October, 09:30–14:00 Imperial Ballroom

The FiO Exhibit is open to all registered attendees. Visit a diverse group of companies representing every facet of the optics and photonics industries. For more information, see page 23.

FedEx Office (Business Center)

+1 408.299.0424

Access your office when you're away from the office at the FedEx Office Print and Ship Center. With premium printing, copying and binding right on site, you can have all of your materials printed to handle any last-minute surprises. Business Center is available 24 hours a day with guest room key accessibility.

FedEx Office Hours

Monday–Friday	08:00–17:30
Saturday–Sunday	Closed

Lost and Found

For Lost and Found please check first at the conference registration counter in the Market Street Foyer. Please put your name on all conference materials (including your Conference Program), as they will only be replaced for a fee.

Special Needs

If you have a disability and require special accommodations in order to fully participate in this conference, please contact Conference Management at the registration desk. Your specific needs will be addressed.

WiFi Access Instructions

To access the complimentary wifi services during the FiO/LS Conference, use the following information to log in. If you require more detailed instructions, a step-by-step access guide is available at the FiO registration desk.

SSID: FIO2015 Password: IYL2015

Women in Optics WiO

Women have made great contributions to science, but there have very often been major barriers and obstacles placed in their path. Despite accounting for nearly half of the college-educated workforce, women in 2010 accounted for less than one-third of S&E employment. Although the number of women in S&E jobs has risen significantly in the past two decades, the disparity has narrowed only modestly. In recognition of the women in optics, we have placed a WiOsymbol by the abstracts of the many women presenters who are contributing to this year's program.

First Aid and Emergency Information

In the event of an emergency at the Fairmont San Jose hotel, go to the nearest house phone and dial "50", advise the operator of your identity and location so they can better assist you. Please only use 911 in the event of a serious situation.

If you have a Security concerns for yourself or others in your group please contact the operator at "0" and you will be put in touch with the Loss Prevention Department.

Medical Facilities

O'Connor Hospital

2105 Forest Avenue, San Jose, California +1 408.947.2500 www.oconnorhospital.com

Good Samaritan Hospital

2425 Samaritan Drive, San Jose, California +1 408.559.2011 www.Goodsamsanjose.com

Sponsoring Society Membership Booths *Market Street Foyer*

APS and OSA Society Booths and IYL Booth Hours

Sunday, 18 October	12:00–17:00
Monday, 19 October	08:00–17:00
Tuesday, 20 October	08:00–17:00
Wednesday, 21 October	08:00–17:00
Thursday, 22 October (IYL Booth Only)	08:00–14:00

APS Booth

Founded in 1899, the American Physical Society (APS) is a non-profit membership organization working to advance and diffuse the knowledge of physics. APS publishes the world's most widely read physics research and review journals: *Physical Review Letters, Physical Review X, Reviews of Modern Physics, Physical Review A-E, Physical Review Applied, Physical Review Special Topics, and Physics.* Please stop by our table near Registration to learn more about the prestigious Physical Review collection.



OSA Booth

All FiO attendees are invited to stop by the OSA Booth.

Not a Member? Join on-site and take advantage of a 50 percent dues discount on the Individual Member category. Sign up at the OSA Booth, which is located near Registration.



International Year of Light Booth

How are you celebrating the International Year of Light? Visit the International Year of Light Booth near Registration to join the global movement to celebrate light. The International Year of Light and Light-Based Technologies (IYL 2015) is a global initiative to raise awareness of how optical technologies promote sustainable development and provide solutions to worldwide challenges in energy, education, communications, and health. IYL programs promote public and political understanding of the central role of light in the modern world while also celebrating noteworthy anniversaries in 2015. Be part of IYL 2015!

http://www.light2015.org



CAM Lounge

OSA is turning 100 in 2016! We're asking all OSA members to be a part of the celebration by participating in short videos. CAM (Centennial Authentic Moments) is an ongoing program of collecting scientific selfies where members will talk about what it means to be an OSA Member, how has OSA helped in their careers, what inspired them to get into the field of optics and what excites them about their current work in three minutes or less. The collection of these short videos will be featured on OSA's centennial website.

CAM Lounge Hours

Sunday, 18 October	12:00–16:00
Monday, 19 October	09:00–16:00
Tuesday, 20 October	09:00–16:00
Wednesday, 21 October	09:00–16:00



Stay Connected

Conference Materials

Technical Digest and Postdeadline Papers

Technical attendees have EARLY (at least one week prior to the conference) and FREE continuous online access to the FiO/LS 2015 technical digest and Postdeadline papers. These 1-2-page summaries of tutorial, invited, and accepted contributed papers can be downloaded individually or by downloading daily .zip files. (.zip files are available for 60 days.)

- 1. Visit the conference website at http://www.frontiersinoptics.com
- 2. Select the "Access Digest Papers" link on the right side of the web page
- 3. Log in using your email address and password used for registration. You will be directed to the conference page where you will see the .zip file links at the top of the page. [Please note: if you are logged in successfully, you will see your name in the upper right-hand corner.]

Access is limited to Full Technical Attendees only. If you need assistance with your login information, please use the "forgot password" utility or "Contact Help" link.

Conference Program Update Sheet

Technical program changes received just prior to the meeting will be communicated in the onsite Conference Program Update Sheet distributed with your onsite registration materials. In addition, all updates will be made in the FiO/LS mobile app. We encourage you to review them carefully to stay informed on changes to the program.

Program Playback: Recorded Content D

We are delighted to announce we are continuing to offer this valuable enhancement free to FiO/LS full technical registrants. More than 40% of the sessions at this year's conference is being digitally captured for on-demand viewing. The pre-selected content includes the plenary presentations and selected hot topics representing the full breadth of the FiO program. Session content will be available for on demand viewing until **23 December 2015**. All captured session content will be live for viewing within forty-eight hours of being recorded. Just look for the symbol in the Agenda of Sessions to easily identify the presentations being captured.

- 1. Visit the conference website at **www.frontiersinoptics.com**
- 2. Select the purple "View Presentations" link on the right side of the web page
- 3. Log in using your email address and password used for registration. You will be directed to the conference page where you will see the .zip file links at the top of the page. [Please note: if you are logged in successfully, you will see your name in the upper right-hand corner.]

Access to the recorded sessions is limited to full technical attendees only.

Poster Presentation PDFs



Authors presenting posters have the option to submit the PDF of their poster, which will be attached to their papers in OSA Publishing's Digital Library, formally known as Optics InfoBase. If submitted, poster PDFs will be available about three weeks after the conference end date. While accessing the papers in OSA Publishing's Digital Library, look for the multimedia symbol (above).

Exhibit Buyers' Guide

The Exhibit Buyers' Guide is composed of descriptions and contact information for exhibiting companies at this year's conference, and exhibit hall activities. Guides will be provided to every FiO/LS attendee as part of registration. All exhibitor information changes will be communicated in the FiO/ LS mobile application. We encourage you to review the mobile application carefully to stay informed of changes to the program.

Program Updates Board

Onsite Program changes will be posted on an update board located at the registration desk. Check daily for new information and/or refernce the FiO/LS mobile app.

Join the Social Conversation at FiO/LS 2015!

We will be providing the latest updates throughout the conference using Twitter. Do you have a Twitter handle?! Follow @Opticalsociety on Twitter. Tweet about your conference experience using #FiO15 in your tweets. Stop by the OSA booth for more details.

> Join the conversation. Follow @Opticalsociety on Twitter. Use hashtag **#Fi015**

Young Professional Bloggers

Watch for OSA's own Young Professional and Student Bloggers reporting on conference events and their unique experiences at FiO! The Luminous Insights Blog posts will be shared via the Conference Twitter stream #FiO15

FiO/LS Mobile Application

Frontiers in Optics/Laser Science 2015 (FiO/LS 2015) has gone mobile again this year using CrowdCompass! We strongly encourage you to download our mobile guide to enhance your experience at FiO/LS 2015. You'll be able to plan your day with a personalized schedule and browse exhibitors, maps and general show info.

Schedule

Search for conference presentations by day, topic, speaker or program type. Plan your schedule by setting bookmarks on programs of interest. Technical attendees can access technical papers within session descriptions.

Exhibit Hall

Search for exhibitors in alphabetical order, and set a bookmark reminder to stop by their booth. Tap on the map icon within a description, and you'll find their location on an expo floor map. View a daily schedule of all activities occurring on the show floor.

Attendees

All FiO/LS registered attendees are listed in the app. Send a contact request to an attendee, and initiate another valuable networking opportunity.

Download the App

The app is compatible with iPhone, iPad, iPod Touch and Android devices.

To get the guide, choose one of the methods below:

- 1. Visit **www.frontiersinoptics.com/app** to down-load the application.
- Scan the following image with your mobile phone (QR-Code reader required, e.g. 'Red Laser', 'Barcode Scanner')



2016 OSA Optics and Photonics Topic	al Meetings and Congresses	Submit your abstract by:
High-Intensity Lasers and High-Field Phenomena (HILAS) Mid-Infrared Coherence Sources (MICS) Compact (EUV & X-ray) Light Sources	OSA High-Brightness Sources and Light-Driven Interactions Congress 20–22 March Long Beach, California, USA osa.org/HighBrightnessOPC	18 November 2015
Cancer Imaging and Therapy Clinical and Translational Biophotonics Optics and the Brain Optical Tomography and Spectroscopy	OSA Biomedical Optics Congress 25–28 April Fort Lauderdale, Florida, USA osa.org/biomed	16 December 2015
OSA Optical Interference Coatings (OIC)	19–24 June Tucson, Arizona, USA osa.org/oic	25 February 2016
OSA Propagation through and Characterization of Atmospheric and Oceanic Phenomena Topical Meeting	27-29 June Washington, DC, USA osa.org/pcDVT	February 2016
OSA International Conference on Ultrafast Phenomena (UP)	17–22 July Santa Fe, New Mexico, USA osa.org/up	26 January 2016
Integrated Photonics Research, Silicon, and Nano-Photonics Novel Optical Materials and Applications Optical Sensors Photonic Networks and Devices Signal Processing in Photonic Communications Specialty Optical Fibers	OSA Advanced Photonics Congress 17–21 July Vancouver, Canada osa.org/PhotonicsOPC	15 March 2016
3D Image Collection and Display Adaptive Optics: Analysis, Methods & Systems (AO) Applied Industrial Optics (AIO) Computational Optical Sensing and Imaging (COSI) Digital Holography & 3-D Imaging (DH) Imaging Systems and Applications (IS) Laser Applications to Chemical, Security and Environmental Analysis (LACSEA) Mathematics in Imaging	OSA Imaging and Applied Optics Congress 25–28 July Heidelberg, Germany osa.org/ImagingOPC	22 March 2016
OSA Latin America Optics & Photonics Conference (LAOP)	08–11 August Medellin, Colombia osa.org/laop	05 April 2016
Australian Conference on Optical Fibre Technology (ACOFT) Bragg Gratings, Photosensitivity and Poling in Glass Waveguides (BGPP) Nonlinear Photonics (NP)	OSA Photonics and Fiber Technology Congress 05–08 September Sydney, Australia osa.org/FiberandPhotonicsOPC	03 May 2016
OSA Advanced Solid State Lasers Conference and Exhibition (ASSL) OSA Application of Lasers for Sensing & Free Space Communication (LS&C)	30 Oct-04 Nov Boston, Massachusetts osa.org/assl; osa.org/lsc	June 2016
Optical Nanostructures and Advanced Materials for Photovoltaics (PV) Optics and Photonics for Energy & the Environment (E2) Optics for Solar Energy (SOLAR) Solid-State and Organic Lighting (SOLED)	OSA Light, Energy and the Environment Congress November/December Leipzig, Germany osa.org/EnergyOPC	August 2016

Conference Plenary Sessions and Awards Ceremony

Tuesday, 20 October, 08:00–09:30 and Wednesday, 21 October, 08:00–09:30 *Regency Ballroom*

Join your colleagues to recognize recent OSA and APS/Division of Laser Science award and honor recipients. The sessions include the Ives Medal Address, the Schawlow Prize Lecture and two plenary presentations.

The order of events:

Tuesday, 20 October

Welcome

LIGO and the Coming Dawn of Gravitational Wave Physics and Astronomy, David Reitze, *Caltech, USA*

OSA Award and Honor Presentations

Ives Medal Lecture – Optical Coherence Tomography – Translating Technology to Clinical Practice, James G. Fujimoto, MIT, USA

Closing Remarks

Wednesday, 21 October

Welcome

Astrophotonics: Future Developments in Astrophysics and Instrumentation, Joss Bland-Hawthorn, University of Sydney, Australia

OSA Fellow Member and Honorary Member Presentations

Schawlow Prize Lecture – Using Light to Build Quantum Networks of Atoms, Christopher Monroe, University of Maryland, USA

Closing Remarks

Plenary Presentations



Astrophotonics: Future Developments in Astrophysics and Instrumentation, Joss Bland-Hawthorn, University of Sydney, Australia

Over the past 15 years, astrophotonics – the interface between photonics and astronomical/ space instrumentation – has led to important advances in adaptive

optics, laser communications, interferometry, vortex coronography, precision spectroscopy through fibre etalons, filtering through photonic lanterns and multicore fibre gratings, and so on. There is an important role here for nanophotonics if nano-patterning can be achieved over large surfaces (~100mm OD).

These advances will be exploited by a new generation of astronomical instruments, as we describe. The case for photonics becomes even more compelling in an era of extremely large telescopes (25-42m aperture) now under construction.

Joss is one of Australia's leading astronomers. He was born in Kent, England, educated in Oxford and Birmingham, before coming to Australia in 1982 to undertake a PhD. In the period 1985-1993, Joss was an astrophysicist at the Institute for Astronomy in Hawaii, a Fellow at the Institute for Advanced Study Princeton, and a professor of physics at Rice University Texas. In 1993, he returned to work at the Anglo-Australian Observatory, Sydney, eventually to become Head of the research and development team.

In 2007, he moved to the University of Sydney to take up an Australian Federation Fellowship. In 2014, he was awarded an Australian Laureate Fellowship to continue his work in astrophysics and astrophotonics. Today he is the Director of the Sydney Institute of Astronomy and Principal Investigator for the Sydney Astrophotonic Instrumentation Labs.

He has been the recipient of many prizes including the Muhlmann Prize in 2009 (USA) and the Jackson-

Gwilt Medal in 2012 (UK). In 2010, Joss was the Merton College Fellow and the Leverhulme Professor at Oxford. In 2012, Joss was elected to the Australian Academy of Science, an august body of Australia's 400 leading scientists, and The Optical Society. He has published 400 refereed papers with 30,000 citations and an h-index of 80.



LIGO and the Coming Dawn of Gravitational Wave Physics and Astronomy, David Reitze, Caltech, USA

For the past 50 years, researchers have searched in vain for gravitational waves, miniscule ripples in space-time emitted from the most violent events in the cosmos. To

move gravitational-wave detection beyond the realm of impossibility, we have just finished construction on Advanced LIGO, a pair of 4 km arm length laser interferometers capable of measuring displacements approaching 10⁻¹⁹ m at their most sensitive frequencies, redefining the meaning of 'extreme precision measurement'. LIGO brings together high energy astrophysics and many aspects of optical science and engineering in a unique way with the ambitious goal of detecting gravitational waves and opening a new window onto the universe.

David Reitze holds positions as both the Executive Director of the Laser Interferometer Gravitationalwave Observatory (LIGO) Laboratory at the California Institute of Technology and a Professor of Physics at the University of Florida. Based at Caltech, he heads a laboratory of 180 scientists and engineers responsible for the construction and operation of the LIGO interferometers at Hanford WA and Livingston LA.

Upon completing a B.A. in Physics from Northwestern University in 1983, he obtained a Ph.D. in Physics from the University of Texas at Austin in 1990 where his research on ultrafast solid-liquid phase transitions solved a hundred year old problem on the nature of liquid carbon. Since then, he has worked extensively in the fields of ultrafast laser spectroscopy and experimental gravitation-wave detection. From 2007-2011, he served as the Spokesperson of the LIGO Scientific Collaboration, a group of almost 1000 scientists who carry out the science program of LIGO.

His current research interests focus on development of precision interferometric methods approaching the zeptometer level and on the search for gravitational waves from astrophysical sources. A Fellow of the American Physical Society and The Optical Society, he has authored nearly 250 refereed publications. Since 2012, one of his main efforts has been directed toward establishing a third LIGO interferometer in India.

Awards Ceremony

APS Arthur L. Schawlow Prize and Lecture

Awarded by the Division of Laser Science of the American Physical Society, the 2015 Arthur L. Schawlow Prize in Laser Science recognizes outstanding contributions to basic research that uses lasers to advance our knowledge of the fundamental physical properties of materials and their interaction with light.

2015 Arthur L. Schawlow Prize in Laser Science Recipient



Using Light to Build Quantum Networks of Atoms, Christopher Monroe, Joint Quantum Institute and University of Maryland, USA

For pioneering research in the use of lasers to realize the elements of quantum information processing with trapped atomic ions, including demonstrations of remote

entanglement for quantum communication protocols and use of frequency combs for high-speed qubit manipulation and entanglement.

Laser-cooled atomic ions are standards for quantum information science, acting as qubit memories with unsurpassed levels of quantum coherence while also allowing near-perfect measurement. When qubit state-dependent optical dipole forces are applied to a collection of trapped ions, their Coulomb interaction is modulated in a way that allows the entanglement of the gubits through guantum gates that form the basis of a quantum computer. Similar optical forces allow the simulation of quantum many-body physics, where recent experiments are approaching a level of complexity that cannot be modelled with conventional computers. Scaling to much larger numbers of gubits can be accomplished by coupling trapped ion gubits through optical photons, where entanglement over remote distances can be used for quantum communication and large-scale distributed guantum computers. Laser sources and quantum optical techniques are the workhorse for such quantum networks, and will continue to lead the way as future quantum hardware is developed.

Christopher Monroe is an experimental atomic physicist who specializes in the isolation of individual atoms for studies in quantum physics and applications in quantum information science. After getting his undergraduate degree from MIT, Monroe studied with Carl Wieman at the University of Colorado, earning his PhD in Physics in 1992.

From 1992-2000 he was a postdoc then staff physicist at the National Institute of Standards and Technology, in the group of David Wineland. With Wineland, Monroe led the research team that demonstrated the first quantum logic gate in 1995, and exploited the use of trapped atoms for applications in quantum information science. In 2000, Monroe became Professor of Physics and Electrical Engineering at the University of Michigan, where he pioneered the use of single photons to couple quantum information between atoms and also demonstrated the first electromagnetic atom trap integrated on a semiconductor chip.

From 2006-2007 he was the Director of the National Science Foundation Ultrafast Optics Center at the University of Michigan. In 2007 he became the Bice Zorn Professor of Physics at the University of Maryland and a Fellow of the Joint Quantum Institute. In 2008, Monroe's group succeeded in producing quantum entanglement between two widely separated atoms and for the first time teleported quantum information between matter separated by a large distance. Since 2009 his group has investigated the use of ultrafast laser pulses for fast quantum entanglement operations and also pioneered the use of trapped ions for quantum simulations of many-body models related to quantum magnetism.

Frederic Ives Medal /Jarus W. Quinn Prize

Recognizing overall distinction in optics, the Frederic Ives Medal is the highest award of the Society. It was endowed in 1928 by Herbert E. Ives, a distinguished charter member and 1924-1925 OSA President, to honor his father, who was noted as the inventor of modern photoengraving and who made pioneering contributions to color photography, three-color process printing, and other branches of applied optics. The medalist is asked to present a plenary address at OSA's Annual Meeting. The prize is funded by the Jarus W. Quinn Ives Medal Endowment, raised by members at the time of Quinn's retirement in recognition of his 25 years of service as OSA's first Executive Director. This year's Frederic Ives Medal/Jarus W. Quinn Prize will be presented to James G. Fujimoto for pioneering the field of optical coherence tomography (OCT) and for leading the field to widespread medical application and major commercial impact.



Optical Coherence Tomography – Translating Technology to Clinical Practice

James G. Fujimoto, Massachusetts Institute of Technology, USA

Optical coherence tomography (OCT) is based on photonics and has had a powerful impact in medicine and research. This pre-

sentation describes the history, recent advances and process of translating OCT technology from laboratory to clinic.

James G. Fujimoto obtained his bachelors, masters, and doctorate from the Massachusetts Institute of Technology. He performed his doctoral studies under the supervision of Prof. Erich Ippen in ultrafast optics. Since 1985 Dr. Fujimoto has been in the Department of Electrical Engineering and Computer Science and Research Laboratory of Electronics at MIT where he is

currently Elihu Thomson Professor of Electrical Engineering. Dr Fujimoto's group and collaborators were responsible for the invention and development optical coherence tomography (OCT). His group's paper, "Optical Coherence Tomography," which appeared in Science in 1991 has remained one of the highest cited papers in the field of biophotonics. OCT is now standard clinical imaging modality in ophthalmology for the detection and treatment monitoring of macular degeneration, diabetic retinopathy and glaucoma. There are an estimated 20-30 million ophthalmic imaging procedures performed worldwide every year. There are hundreds of researchers internationally working on OCT in such diverse fields as cardiology, endoscopy and cancer surgery. Last year, the global sales of OCT systems exceeded 400 million US dollars and there are ~40 OCT systems companies.

Dr. Fujimoto has been influential as an educator and is also active in scientific service, having served as co-chair of international meetings such as the Conference on Lasers and Electro Optics, the European Conferences on Biomedical Optics, and Ultrafast Phenomena. Since 2003 Dr. Fujimoto has served as co-chair of the SPIE Biomedical Optics symposium, the largest international meeting on biophotonics. He served as a Director of the OSA from 2000 to 2003 and is currently serving as a Director of the SPIE.

Working with Mr. Eric Swanson, Dr. Fujimoto was a co-founder of the startup company Advanced Ophthalmic Devices, which developed OCT for ophthalmic imaging and was acquired by Carl Zeiss. The team also co-founded LightLab Imaging, which developed cardiovascular OCT and was acquired by Goodman, Ltd and St. Jude Medical.

Dr. Fujimoto received the Discover Magazine Award for Technological Innovation in 1999, was co-recipient of the Rank Prize in Optoelectronics in 2002, received the Zeiss Research Award in 2011, was co-recipient of the Champalimaud Vision Prize in 2012 and received the IEEE Photonics Award in 2014. He is in the National Academy of Engineering, American Academy of Arts and Sciences, and National Academy of Sciences. Dr. Fujimoto is also a Fellow of the OSA, SPIE, APS and IEEE.

APS/Division of Laser Science Award

Arthur L. Schawlow Prize

Christopher Monroe, University of Maryland, USA

OSA Awards and Honors

OSA Fellowships

Peter E. Andersen, *Danmarks Tekniske Universitet*, *Denmark*

Adela Ben-Yakar, University of Texas at Austin, USA

Robert P. Breault, Breault Research Organization Inc., USA

P. Scott Carney, University of Illinois at Urbana-Champaign, USA

Dean R. Evans, U.S. Air Force Research Laboratory, USA

John Charles Howell, University of Rochester, USA

Yunjiang Rao, University of Electronic Science and Technology of China, China

David Howard Reitze, California Institute of Technology, USA

OSA Honorary Member

Robert W. Hellwarth

2015 Frederic Ives Medal/Jarus W. Quinn Prize

James G. Fujimoto, Massachusetts Institute of Technology, USA

For pioneering the field of optical coherence tomography (OCT) and for leading the field to widespread medical application and major commercial impact.

Esther Hoffman Beller Medal

Govind P. Agrawal, *University of Rochester, USA* For inspiring and educating a generation of scientists and engineers involved with fiber optic communications and other photonics technologies through his seminal textbooks and high-impact scientific articles.

Max Born Award

John D. Joannopoulos, Massachusetts Institute of Technology, USA

For numerous contributions to nanophotonics, including pioneering the "numerical experiments" approach for nanophotonics.

Michael S. Feld Biophotonics Award

Bruce Jason Tromberg, Beckman Laser Institute and Medical Clinic, University of California, Irvine, USA For serving as an advocate for and a leader of the biophotonics community as well as for pioneering the development and clinical application of spatially and temporally modulated light imaging.

Paul F. Forman Team Engineering Excellence Award

Logic Analysis Tool Team (or LAT Team), Fremont, California, USA

For the development and characterization of the Logic Analysis Tool that detects photon emissions from integrated circuits fabricated in advanced process technologies with operating voltages down to 0.5 V.

Joseph Fraunhofer Award/Robert M. Burley Prize

Russell A. Chipman, *University of Arizona, USA* For outstanding contributions in the development of metrology facilities for imaging polarimetry and spectro-polarimetry.

Nick Holonyak, Jr. Award

Qing Hu, Massachusetts Institute of Technology, USA For pioneering contribution to high-performance THz quantum-cascade lasers and their applications in imaging and sensing.

Edwin Land Medal (co-sponsored with IS&T)

Joseph Mangano, DARPA, USA, Mordechai Rothschild, MIT Lincoln Laboratory, USA, and David Shaver, DARPA, USA

For contributions to the excimer laser ArF and modern deep-UV photolithography for the semiconductor industry.

Emmett Leith Medal

Yeshaiahu Fainman, *University of California, San Diego, USA* For extension of Fourier optics methods to the femtosecond and nanometer regimes.

Ellis R. Lippincott Award

Dana D. Dlott, University of Illinois at Urbana-Champaign, USA

For the development of methods to measure vibrational energy flow in molecules with ultrafast time and atomic length scale resolution

Adolph Lomb Medal

Jeremy Nathan Munday, *University of Maryland, USA* For pioneering contributions to plasmonic and photonic light-trapping in solar cells.

C. E. K. Mees Medal

Warren Sloan Warren, *Duke University, USA* For the development of controlled laser pulses and nonlinear imaging techniques to enable applications ranging from clinical diagnosis to scientific analysis of Renaissance artwork.

William F. Meggers Award

Paul S. Julienne, National Institute of Standards and Technology (NIST), USA

For seminal contributions to precision photoassociation and magnetic-Feshbach spectroscopy of ultracold atoms, and the application of these techniques to the formation of cold polar molecules

David Richardson Medal

Daniel R. Neal, *Abbott Medical Optics Inc., USA* For innovative technical leadership in the design, fabrication, and commercialization of wavefront sensing devices.

R. W. Wood Prize

Naomi Halas and Peter Nordlander, *Rice University, USA*

For introducing nanoparticles with tunable optical resonances and the concept of plasmon hybridization to explain their properties and revolutionizing the understanding of optical properties of metallic nanostructures OSA's awards and medals are endowed through the OSA Foundation. The OSA Foundation is proud to support this prestigious program and recognize outstanding contributions in optics and photonics. For more information about the OSA Foundation, please visit www.osa.org/foundation or contact staff at foundation@osa.org.





Awards and Special Recognitions

OSA Foundation Boris P. Stoicheff Memorial Scholarship

Established in 2011 by the OSAF and the Canadian Association of Physicists Educational Trust Fund (CAP-ETF), this program pays tribute to Boris P. Stoicheff, an internationally renowned laser spectroscopist who also served as President of OSA (1976) and CAP (1983-84).This \$3,000 scholarship is awarded annually to a graduate student who has demonstrated both research excellence and significant service to the optics or physics community.

Congratulations to our 2015 award recipient:

Itai Epstein, Tel-Aviv Univ., Israel

OSA Foundation Emil Wolf Outstanding Student Paper Competition

This competition recognizes the innovation, research excellence and presentation abilities of students presenting their work during FiO and honors Emil Wolf for his many contributions to science and The Optical Society. One winner is selected from each of the seven FiO subcommittees. Winners receive a complimentary OSA student membership, an award stipend of \$300 USD and an award certificate.

Congratulations to our finalists competing at FiO:

FiO 1: Optical Design and Instrumentation

Zachary De Santis, Univ. of Rochester, USA Dennis Floyd Gardner, Univ. of Colorado at Boulder, USA

FiO 2: Optical Sciences

Omar Santiago Magana Loaiza, Univ. of Rochester, USA

Scott Wandel, Pennsylvania State Univ., USA Daniel Maser, National Inst. of Standards & Tech, USA

FiO 3: Optics in Biology and Medicine

Dan MacDougall, Dalhousie Univ., Canada Colin Constant, Univ. of Central Florida, CREOL, USA **FiO 4: Fiber Optics and Optical Communications** Hui Chen, Stevens Inst. of Tech., USA

Haomin Yao, The Inst. of Optics, Univ. of Rochester, USA Eduardo Temprana, UCSD, USA

FiO 5: Integrated Photonics

Yannick Salamin, ETH Zurich, Switzerland Kenneth M. Goodfellow, Univ. of Rochester, USA Michael G. Wood, Ohio State Univ., USA

FiO 6: Quantum Electronics

Claire Autebert, Laboratory MPQ, France Jianwei Wang, Centre for Quantum Photonics, H.H. W., UK

FiO 7: Vision and Color

Rebecca Holmes, Univ. of Illinois at Urbana-Champaign, USA

OSA Foundation Incubic/Milton Chang Travel Grant

Funded by an endowment from Milton and Rosalind Chang, this program provides 10 grants of \$500 USD each to enable students who present papers to travel to the Frontiers in Optics. Grants are awarded to the presenter and usually the first author of the paper. Congratulations to the 2015 Incubic/Milton Chang Travel Grant Recipients:

Aadhi A., Physical Research Laboratory, India
Alem Gebru, Univ. of Stellenbosch, South Africa
Haomin Yao, Univ. of Rochester, USA
H. Esat Kondakci, Univ. of Central Florida, USA
Itai Epstein, Tel-Aviv Univ., Israel
Litty V. Thekkekara, Swinburne Univ. of Technology, Australia
Milad I. Akhlaghi, Univ. of Central Florida, USA
Moshe G. Harats, The Hebrew Univ. of Jerusalem, Israel
Omar Calderon-Losada, Universidad de los Andes, Colombia

Vishwatosh Mishra, IIT Kharagpur, India

OSA Foundation Jean Bennett Memorial Student Travel Grant

Established in 2008, in memory of Jean M. Bennett, a highly decorated research physicist who was recognized for her contributions to the studies of optical surfaces and served as OSA's first female president, this \$1,000 USD grant is awarded to a student presenting their work at FiO. This competition is administered by the OSA Foundation and is made possible through the generous support of Nanoptek Corporation, the Pennsylvania State Univ. Department of Physics and individual contributors.

Congratulations to our 2015 grant recipient:

Zi Jing Wong, Univ. of California, Berkeley, USA

OSA Foundation Student Travel Grants

The OSA Foundation is pleased to provide travel support to help students from developing nations attend FiO. Each grant recipient receives \$1,500 USD to offset costs associated with traveling to the conference.

Congratulations to our 2015 grant recipients:

Aadhi A., Physical Research Laboratory, India
Anirban Sarkar, IIT Kharagpur, India
Catalina Hurtado Castaño, Universidad Nacional de Colombia, Colombia
Franciele Renata Henrique, Univ, of Sao Paolo, Brazil
Inga Saknite, Univ. of Latvia, Latvia
Luis Joel Mávita Granillo, CICESE, Mexico
Nithyanandan K., Pondicherry Univ., India
Praveen Phinehas M, Vellore Inst. of Technology (VIT), Chennai, India
Sonika Obheroi, Vellore Inst. of Technology (VIT), Chennai, India
Tsung-Han Tsai, National Taiwan Univ., Taiwan

OSA Foundation Robert S. Hilbert Memorial Student Travel Grant

Established in 2009 by Optical Research Associates (ORA), now the Optical Solutions Group at Synopsys, as a memorial to ORA's former President and Chief Executive Officer Robert S. Hilbert, this \$1,100 USD grant recognizes the research excellence of students in the areas of optical engineering, lens design and illumination design.

Congratulations to our 2015 grant recipients:

Haoran Ren, Swinburne Univ. of Technology, Australia Nithyanandan K., Pondicherry Univ., India

Carl E. Anderson Award for Outstanding Doctoral Dissertation

The Carl E. Anderson Award for Outstanding Doctoral Dissertation in Laser Science was established in 2013 by the American Physical Society (APS) Division of Laser Science (DLS). Its purpose is to recognize doctoral research in the Laser Science area and to encourage effective written and oral presentation of research results. The award consists of \$1,000 USD and a certificate citing the contribution made by the recipient. The finalists will present their work at a special session of the Laser Science conference on Monday, 19 October from 08:00–10:00 in the Hillsborough Room. The winner will be announced during the Laser Science Banquet on Tuesday, 20 October from 19:00–22:00 (Gordon Biersch, 33 East San Fernando St., San Jose, CA).

OSA Foundation Grant Recipients

The OSA Foundation benefitted more than 9,400 people in 2014. We inspire future optics innovators, support career development for optics students, recent graduates and young professionals, and recognize distinguished achievement in the field through the presentation of awards and honors.

We would like to congratulate our 2015 grant recipients. Through the following programs we have been able to provide over 30 grants to help students attending FiO. For more information on who we are and what we do, visit www.osa.org/Foundation.

You can help to inspire and support the next generation of science and engineering innovators by making a donation to the OSA Foundation. For a limited time, all donations are matched 100% by the Optical Society—so your gift has twice the impact. To learn more and to make a donation online, visitwww.osa.org/foundation, or stop by the OSA booth.



Special Symposia

Townes Symposium: Reminiscences — Scientific and Personal

Sunday, 18 October, 16:30–18:30 Regency Ballroom

Organizer: Elsa Garmire, Dartmouth College, USA



In 1958, at Bell Laboratories, Charles Hard Townes, one of the foremost pioneers of quantum electronics, and Arthur Schawlow invented the laser, explaining its geometry, operating principles and presenting its foundational theory. The laser, operating at optical frequencies, was based on Townes's invention at Columbia

University of the maser (microwave analog of the laser) which he demonstrated experimentally in 1954. Townes received the Nobel Prize in 1964, along with Soviet scientists Nikolai Basov and Alexander Prokhorov.

This symposium brings together participants from every step of his professional career, including Joseph Giordmaine, who was his student at Columbia. In 1961 Townes moved to MIT as Provost while he ran a research group in nonlinear optics, contributing pioneering ideas to stimulated Raman and Brillouin scattering, self-trapping and self-phase modulation. Raymond Chiao and Elsa Garmire were his students at MIT and Paul Kelley was a colleague from Lincoln Laboratory. In 1967, Townes moved to University of California at Berkeley; Robert Boyd was his student there in nonlinear optics, and Kenneth Gustafson was a colleague. Townes spent the last half of his life investigating Quantum Electronics in astronomy. Former Berkeley astronomy student Paul Goldsmith, now at JPL, will describe the new ideas Townes brought to astronomy. Finally, Martin Richardson, director of the Townes Laser Institute at University of Central Florida, will describe Townes' dynamism during the last ten years of his life. These panelists will provide an overview of this extraordinary scientist's approach

to research and teaching. Townes passed away in January 2015 at the age of 99.

Invited Speaker:

Paul Goldsmith, NASA Jet Propulsion Laboratories, USA

Panelist:

Robert Boyd, Univ. of Rochester, USA; Univ. of Ottawa, Canada

Raymond Chiao, Univ. of California Merced, USA

Joseph Giordmaine, AT&T and NEC Labs (retired), USA

Kenneth Gustafson, Univ. of California Berkeley, USA

Paul Kelley, The Optical Society; Tufts Univ. (retired), USA

Martin Richardson, Townes Laser Institute, Univ. of Central Florida, USA

International Year of Light – Science to Solutions Special Session

Monday, 19 October, 16:00–18:00 Regency Ballroom

Moderator: Eric Mazur, Harvard University, USA

The International Year of Light Special Session, open to the public, will showcase examples of how optics has made, and will make, a difference in society. Speakers will highlight the connection between fundamental scientific research to solutions to problems with societal impact. The topical coverage will span issues such as energy, climate, health care, and telecommunications. The talks are intended to be short (10-20 min), in TED-talk style, designed to engage and inspire. Registered technical attendees are also encouraged to attend the International Year of Light/ OSA Presidents Reception - "Light up the Night" from 18:30–20:30 at the City Hall Rotunda.

Invited Speakers



Nonlinear Optics: The Good, Bad, Ugly, Beautiful, Elsa Garmire, Dartmouth College, USA WiO

Abstract: Nonlinear Optics can be many things: good when creating new frequencies, improving lasers, manufacturing, offering new science; bad when damaging

optics; ugly in telecommunications by limiting signals through fibers; beautiful when creating solitons.



Space Based Measurements of Atmospheric Carbon Dioxide: A New Tool for Monitoring Our Environment, David Crisp, Jet Propulsion Laboratory, NASA, USA

Abstract: Precise, global measurements of atmospheric carbon dioxide and other greenhouse gases by the NASA Orbiting Car-

bon Observatory-2 (OCO-2) and other satellites provide new tools to monitor and manage the processes that control their atmospheric concentrations.



Biophotonics and the Future of Personal Health Monitoring, Bruce Tromberg, University of California at Irvine, USA

Abstract: Medical Optics provide unique, dynamic information about tissue structure and biochemical composition. Matching technologies with

clinical needs will reduce health care costs and drive the development of wearable, bedside technologies for personalized medicine.





Computing at the Speed of Light, Michal Lipson, Columbia Univ., USA WiO

Abstract: By 2020, data centers will consume in the US alone more than 250 megawatts of electricity. As Data-centers are expected to carry a large portion if not the majority of all kinds of computa-

tions in the future, driving this power consumption down is a major engineering, industrial as well as political concern. Light as a means for propagating high amounts of computing data, is recognized today as the most promising direction for solving this paradigm. Light, in contrast to electronics, does not dissipate power as it propagates. The challenge with this approach is that until recently silicon- the basic material used in microelectronics and computing today- has been considered a low quality optical material. We have shown the ability to control the flow of light. at GHz frequencies using a nano-structure that enhance the natural electro-optic properties of silicon. This ability to create active optical devices on silicon is the basis for the burgeoning field of silicon photonics, or light on a silicon chip.



Applications of Laser Spectroscopy to Meet Challenges in Medicine, Katarina Svanberg, Lund Laser Centre, Switzerland WiO

Abstract: Laser spectroscopy is a valuable tool both in the detection and the therapy of human malignancies. The most important

prognostic factor for cancer patients is early tumor discovery. If malignant tumors are detected during the non-invasive stage, most tumors show a high cure rate of more than 90 %. Laser-induced fluorescence (LIF) can be used for monitoring the biomolecular changes in tissue under transformation from normal to dysplastic tissue and further to cancer before structural morphological changes are seen at a later stage. Photodynamic therapy is a selective therapy modality for human malignancies. To overcome the limited light penetration in superficial illumination interstitial delivery (IPDT) with the light transmitted to the tumors via optical fibers has been developed. Interactive feed-back dosimetry is of importance for optimizing this modality and such a concept has been developed. Another technique is based on gas in scattering media absorption spectroscopy (GAS-MAS). It can be used to detect free gas (oxygen and water vapor) in hollow organs in the human body and has been applied to the detection of the human sinus cavities. It might guide in the therapy choice for infections whether to prescribe antibiotics or not. The technique may also be a valuable tool for surveillance of prematurely born infants.



How Light Shaped Science: From Fleas to Qubits, Ian Walmsley, University of Oxford, UK

Abstract: Optics is among the oldest branches of science, and yet remains among the most fruitful. It has provided either new phenomena or new technology that underpin many of the major

discoveries in physics over the past 400 years. Yet it is only in the past century that its disparate properties have been understood in a unified way, and even now there are new insights into the structure of the natural world emerging from this understanding. And, as is so often the case, new technologies are also emerging, which promise once again to open new vistas in science and new applications that will change society.

Symposium on Photoreceptor Analysis and Single-cone-mediated Vision Monday, 19 October, 08:00–10:00

Crystal

Organizer: Brian Vohnsen, Univ. College Dublin, Ireland

Twenty-five years ago detailed post-mortem ocular histology gave spectacular insight into the organization of cone and rod photoreceptor cells in the human retina. Subsequent progress with implementation of adaptive optics for aberration correction has made in-vivo analysis of single retinal cells feasible in both the healthy eye and in eyes affected by disorders. The same technologies allow vision to be explored at the fundamental limit set by the size and spacing of single photoreceptors and ganglion cells. This symposium will highlight milestones that have made these advances feasible with state-of-the-art technologies and address outstanding challenges for the implementation of improved diagnostic capabilities that not only will increase our understanding of the last optical steps of the visual process but also help combat vision loss.

Invited Speakers:

Human Photoreceptor Topography - 25 Years and Looking Ahead, Christine Curcio, Univ. of Alabama at Birmingham, USA

Single Cell Imaging In Photoreceptor Degenerative Disease, Christopher Langlo, *Medical College of Wisconsin, USA*

Waveguide Properties of Cone Photoreceptors, Don Miller, Indiana Univ., USA

Probing Human Spatial and Color Vision on a Cellular Scale, Austin Roorda, Univ. of California Berkeley, USA

Laser Science Symposium on Undergraduate Research

Monday, 19 October, 10:00–16:00 Glen Ellen

Organizer: Harold Metcalf, Stony Brook Univ., USA

This special DLS annual symposium started in 2001 and has rapidly become one of the most successful DLS traditions. During the past several years the number of undergraduates presenting papers has grown from only 10 to more than 40, and the talks have been of outstanding quality, some absolutely stellar. Last year's posters were outstanding and generated a great deal of lively interest and on-the-spot discussion.

This year's symposium will consist of morning poster sessions, along with afternoon oral sessions. The event provides an opportunity for student members for the community, who are already among the finest young scientists to be found anywhere, to present their work before an audience of their peers, as well as the larger optics community. All are invited and encouraged to attend the session.

Symposium on Optics for Global Health and Low Resource Settings

Monday, 19 October, 13:30–15:30 Crystal

Organizer: Laszlo Veisz, Max-Planck-Institute fur Quantenoptik, Germany

Optical sensing allows measurements of important climate-related parameters, such as greenhouse gas and aerosol densities, from both land and spacebased platforms. The measurements are often made at wavelengths where technology is not as mature as in the visible and near-infrared region. Efforts to measure these parameters place stringent demands on light sources (which often must be high power and single frequency), detectors (which must detect the faintest light levels at non-traditional wavelengths), and understanding of long-range propagation effects. Contributions are sought which explore novel approaches to satisfying the demands of optical climate-related measurements.

Invited Speakers:

Measuring Greenhouse Gases from Aircraft and Spacecraft using Lidar, Jim Abshire, NASA Goddard Space Flight Ctr., USA

New Airborne and Ground-based Techniques for Remotely Mapping Multiple Gas Sources and Quantifying Individual Mass Emission Rates, Bill Hirst, BP Shell, USA

Applications of Cavity Ring Down Spectroscopy in the Earth Sciences, Chris Rella, Picarro, USA

Precision Atmospheric Trace Gas Monitoring with Frequency Comb Lasers, Greg Rieker, Univ. of Colorado, USA

Symposium Honoring Adolf Lohmann

Wednesday, 21 October, 11:00–18:15 Sacramento

Organizer: Joseph Mait, US Army Research Laboratory, USA

Contributed papers are encouraged in honor of Adolf W. Lohmann (1925-2013), an OSA Fellow Emeritus known for his contributions to the fields of optical information processing and holography. Topics of particular interest include fractional transformations, phase-space optics, super resolution, temporal optical processing, optical processing with partially coherent light, and flatland optics. To be considered for this symposium submit to the topic category, 1.8 Adolf W. Lohmann Symposium.

Invited Speakers:

Phase-Space Optics, One Photon at a Time, Harry Barrett, Univ. of Arizona, USA

Optical Processing Inside a Degenerate Cavity Laser, Asher Friesem, Weizmann Inst. of Science, Israel

Adolf Lohmann and his Contributions to Optics, Joe Goodman, Stanford Univ., USA

Optical Interconnection - Early Concepts and Novel Approaches, Juergen Jahns, Univ. of Hagen, Germany

Fractional Fourier and Linear Canonical Transforms in Optics, Uriel Levy, The Hebrew Univ. of Jerusalem, Israel

Adolf Lohmann's Approach to Phase-Space Optics, Jorge Ojeda-Castaneda, Univ. of Guanajuato, Mexico

When the Difference Between Coherent and Incoherent Imaging Begins to Blur, Bill Rhodes, Florida Atlantic Univ., USA

Having Fun with Lohmann Optics, Stefan Sinzinger, Technische Univsitat Ilmenau, Netherlands

Symposium on Optical Remote Sensing for the Climate

Wednesday, 21 October, 13:30–15:00 *Crystal*

Organizer: Melissa Skala, Vanderbilt Univ., USA

2015 is the "International Year of Light," and this symposium accordingly highlights the tremendous impact that optical technologies can have on global health. Portable, accurate, and low cost light-based technologies have already demonstrated successes in screening and treatment for an array of pathologies in low resource settings. The potential of these technologies continues to grow with increased interest in engineering world health.

Invited Speakers:

Mobile Technologies for Personalized Diagnostics and Global Health, David Erickson, Cornell Univ., USA

Democratization of Next-Generation Imaging, Sensing and Diagnostics Tools Through Computational Photonics, Aydogan Ozcan, Univ. of California Los Angles, USA

Manu Prakash, Stanford Univ., USA

Low-Cost Optical Diagnostic Systems for Point of Care Applications, Tomasz Tkaczyk, Rice Univ., USA

Symposium on Applications of Low Noise Frequency Combs

Thursday, 22 October, 13:00–17:30 Crystal

Organizer: Bill Kuo, Univ. of California San Diego, USA

Frequency combs have become a hot topic of research over the last decade. Recent methods for generating low-noise frequency combs have spawned a host of new applications, including optical communications, spectroscopy, biomedical applications, signal processing, and numerous sensing applications. This symposium will cover the applications enabled by low-noise, highly coherent frequency combs, and include a panel discussion with the invited speakers.

Invited Speakers:

Perspective of New Infrastructure of Fiber Communication: The Role of Coherent Light in SDM Era, Yoshinori Awaji, *NICT, Japan*

Signal Processing using Optical Frequency Combs, Ronald Esman, *MITRE, USA*

Optical-to-RF Frequency Synthesis: Application Priorities for Ultra-low Phase Noise, David Howe, *NIST, USA*

Exabit Optical Network based on Optical Comb Distribution for High-performance Datacenters: Challenges and Strategies, Takashi Inoue, AIST, Japan

Digital Coherence W-band Radio-over-fiber System, Ken-ichi Kitayama, Univ. of Osaka, Japan

Frequency Combs as Sources for Tbit/s Communications Systems, Juerg Leuthold, ETH, Switzerland

Comb-locked Arbitrary Signal Synthesis, Radan Slavik, *Southampton Univ., UK*

Microwave Generation using Optical Frequency Combs, Steven Wilkinson, Raytheon, USA



OSA Incubators

Collaborate. Innovate. Discover.

OSA Incubators provide unique, focused experiences that connect innovators, deliver insights and spark explorations at the cutting edge of optics. Researchers, engineers and business leaders discuss new and burgeoning fields in a way that cannot be achieved through traditional meetings.

Topics for future OSA Incubators come from accomplished members of the optics and photonics community. Have an idea? Contact us today!

osa.org/incubator

Special Events

Annual OSA Student Chapter Leadership Conference

Sunday, 18 October, 07:00-17:00 Grand Hall Hyatt Place San Jose Downtown, 282 Almaden Boulevard, San Jose, CA

The invitation-only Student Leadership Conference brings together over 200 OSA Student Chapter leaders from around the globe to network, present posters and learn about successful chapter management and the popular International OSA Network of Students (IONS). The program also features professional development presentations from esteemed leaders in the field.

Townes Memorial Reception

Sunday, 19 October, 18:30-20:00 Club Regent, Lobby Level Complimentary for FiO/LS Technical Attendees*





Get the FiO/LS 2015 conference off to a great start by attending the Townes Reception. Meet with colleagues from around the world and enjoy light hors d'oeuvres.

*This event is complimentary for FiO/LS Technical attendees only. Please bring your conference registration badge. Non-technical attendees and guest tickets are available for \$75 USD each.

OSA Student Member Reception

Sunday, 18 October, 19:00-22:00 Da Kine Island Grill, 23 N. Market St., San Jose, CA

This reception is a fun event that encourages Student Members of OSA to meet, enjoy refreshments and have a good time! Note that membership status will be checked.

No charge to all OSA Student Members. Must be 21 or over to consume alcohol.

Frontiers in Photonic Detection Panel Discussion

Monday, 19 October, 12:00–13:30 Belvedere

The OSA Photonic Detection Technical Group will hosting an interactive panel discussion providing an opportunity for professionals and students to learn about and discuss the latest advances in the field of photonic detection. Includes a boxed lunch. RSVP required. Contact TGactivities@osa.org to register, pending availability.



Nonlinear Optics Technical Group Workshop

Monday, 19 October, 12:00-13:30 Atherton

Join the OSA Nonlinear Optics Technical Group for a special workshop including a discussion on future directions in the field of nonlinear optics. Includes a boxed lunch. RSVP required. Contact TGactivities@ osa.org to register, pending availability.



OSA Fellow Members Lunch

Monday, 19 October, 12:00-13:30 Ballroom, The Westin San Jose, 302 S. Market Street, San Jose, CA

Advance reservation for the event was required. Check at the OSA booth to see if there is still space available.

Meet OSA's Journal Editors

Monday, 19 October, 18:00-19:00 Club Regent, Lobby Level

OSA's journal Editors invite you to join them for conversation and refreshments. The Editors welcome your questions, concerns and ideas for the journals, such as:

- What are best practices when submitting your manuscript?
- What constitutes a useful manuscript review?
- What criteria do journal editors look for in submitted manuscripts?
- How do you propose a Feature Issue topic for publication in an OSA Journal?
- Other topics of interest to you

Refreshments will be provided. All are welcome.

OSA Microscopy and Optical Coherence TomographyTechnical Group Poster Session

Monday 19 October, 18:00-19:00 Atherton

Join the Microscopy and Optical Coherence Tomography Technical Group for a focused poster session. This session will bring together students and colleagues for an opportunity to share their latest research findings, exchange ideas, and facilitate collaborations in relevant areas.



International Year of Light/OSA President's Reception - "Light up the Night"

Monday, 19 October, 18:30–20:30 City Hall Rotunda, 200 E. Santa Clara Street, San Jose, CA

Complimentary for FiO/LS Technical Attendees*

OSA President Philip Russell invites you to celebrate the International Year of Light by reaching new heights! Enjoy delicious bites and beverages in City Hall's 110-foot tall Rotunda. Mix and mingle with friends old and new as we light up the night in downtown San Jose.

*This event is complimentary for FiO/LS Technical attendees only. Please bring your conference registration badge. Non-technical attendees and guest tickets are available for \$75 USD each.

The City Hall Rotunda is a short 10 minute walk from The Fairmont Hotel



Better than Fakin' it Good: Multifunctional Bioreplication

Tuesday, 20 October, 12:00–13:30 Fairfield Room, The Fairmont San Jose

Organized by the Environmental Sensing Technical Group, this event will feature a talk by Dr. Akhlesh Lakhtakia of Pennsylvania State University on bioreplication and its use in the eradication of emerald ash borer. Includes a boxed lunch. RSVP required. Contact TGactivities@osa.org to register, pending availability.



Optical Material Studies Technical Group Workshop

Tuesday, 20 October, 12:00–13:30 *Cupertino*

Join the OSA Optical Material Studies Technical Group for a special workshop discussing recent advances in optical materials. Dr. Debashis Chanda of the University of Central Florida will present his talk 'Printed Large Area Flexible Hybrid Photonic-Electronic Systems' as part of this technical group workshop. Includes a boxed lunch. RSVP required. Contact TGactivities@osa.org to register, pending availability.



OSA Student Chapter Competition: IYL-To-Go

Tuesday, 20 October, 14:30–16:00; Winners announced at 16:00. Imperial Ballroom

OSA challenges you to showcase your chapter's best ideas for youth education outreach during its annual meeting Frontiers in Optics/Laser Science. This year's competition is IYL-To-Go. For a chance to win up to \$500 USD for your chapter, we're asking you to create optical demonstrations for children and science teachers that connect with the mission of the International Year of Light to improve public understanding of how light affects our daily lives. These youth education demos should be completely portable and easy to recreate all over the world. Volunteer judges will rate chapters on effectiveness, creativity, presentation and supplies.



Joint FiO/LS Poster Sessions

Tuesday, 20 October, 14:30–16:00 Wednesday, 21 October, 09:30–11:00 Imperial Ballroom

Poster presentations offer an effective way to communicate new research findings and provide a venue for lively and detailed discussion between presenters and interested viewers. Don't miss this opportunity to discuss current research one-on-one with the presenters. The Optical Society will be offering a prize for Best Poster Presentations. Presentations will be judged onsite and the winner will be announced at the conclusion of the conference.

Exhibitor Appreciation Reception

Tuesday, 20 October, 16:00–17:00 Imperial Ballroom



Exhibitors, finish up your first day and come relax and mingle with your fellow exhibitors. Join us in the exhibit hall immediately following the close of the show for some food and beverages sponsored by OSA Industry Development Associates. Join OSA and discover the benefits of Industry Membership. OSA can help corporations optimize product development resources and reduce time to market by giving professionals access to quality information, quality interactions and premium opportunities for collaboration. Join today! Contact industry@osa.org or (202) 416-1482 for more information.

Minorities and Women in OSA (MWOSA) Networking Reception

Tuesday, 20 October, 16:00–17:00 Free of Charge – RSVP Required *Atherton*

Please join the MWOSA community for a networking reception where we will celebrate the OSA Foundation grant award recipients. If you have any questions regarding the event please Email mwosa@osa.org.

Special Events

OSA Annual Business Meeting

Tuesday, 20 October, 17:00–17:45 Fairfield

Learn more about OSA and join the OSA Board of Directors for the Society's annual business meeting. The 2014 activity reports will be presented and the results of the 2015 Board of Directors election will be announced.

APS Division of Laser Science Annual Business Meeting

Tuesday, 20 October, 17:00–18:00 Belvedere

All members and interested parties are invited to attend the annual business meeting of the Division of Laser Science (DLS). The DLS officers will report on the activities of the past year and on plans for the future. Questions will be taken from the floor. This is your opportunity to help define the operations of the DLS and the LS Conference.

OSA Member Reception: Trip the Light Fantastic

An International Year of Light-apalooza Tuesday, 20 October, 18:30–20:30 Grande Ballroom, The Westin San Jose, 302 S. Market Street, San Jose, CA

Complimentary and for OSA Members Only*

The Optical Society cordially invites **OSA Members** to a celebratory night for the International Year of Light.

The poet John Milton wrote, "Com, and trip it as ye go, / On the light fantastick toe." As we start to wind down on this glorious year that focused the world's attention on light, let's take Milton's advice and let loose. For one special evening, OSA Members will enjoy the company of friends and colleagues. We'll provide the beverages, appetizers, and music. You just need to bring your dancing shoes (oh, and your conference registration badge or OSA Membership card). If you join OSA on-site, please bring your receipt.

*This event is complimentary and is for OSA Members. If you would like to bring a guest, tickets are available for \$75 USD each.

Not a member yet? Join today to attend this complimentary OSA Member event.

Laser Science Banquet

Tuesday, 20 October, 19:00–21:00 Gordon Biersch Restaurant, 33 East San Fernando St, San Jose, CA

Join your colleagues for the annual LS Banquet. Tickets are required for this event and can be purchased at registration for US \$65. There is a limited quantity of tickets and tickets must be purchased by 12:00 on Monday, 19 October.

OSA Members, Family and Friends Tour

Wednesday, 21 October, 10:00–12:15 Rosicrucian Egyptian Museum and Planetarium, 1660 Park Ave., San Jose, CA

Bus will depart from the Fairmont San Jose's main entrance at 10:15.

No charge to OSA members and their families. Children are welcome.

Sponsored by OSA Members, Family and Friends

Architecturally inspired by the Temple of Amon at Karnak, the Rosicrucian Egyptian Museum and Planetarium houses the largest collection of Egyptian artifacts on exhibit in western North America, including objects from pre-dynastic times through Egypt's early Islamic era. Voted by Trip Advisor as one of the top sites to visit in San Jose, enjoy a 90-minute guided tour of the museum's exhibits, which focus on gods and religion, kings and pharaohs, and burial practices.

VIP Industry Leaders Networking Event: Connecting Corporate Executives, Recent Graduates and Students

Wednesday, 21 October, 12:30–14:00 Club Regent, Lobby Level

Includes a boxed lunch. RSVP Required.



This session brings together Industry Executives to share their business experience – from how they started their careers, lessons learned along the way, to using their degree in an executive position – with Young Professionals and Students. The program starts with informal networking during lunch and then transitions into "speed meetings" – small, brief visits with 6-8 executives to discuss careers, industry trends or other career topics.

Space is limited. Members of OSA's Young Professionals program will be given registration priority, but students and recent graduates are also welcome and encouraged to register.

On-site registration will be accepted pending availability. Please contact vipevents@osa.org if you would like to register.

To join the Young Professionals program, email yp@osa.org.

Meet the Editors of the APS Journals

Wednesday, 21 October, 13:00–14:30 Imperial Ballroom

The Editors of the APS journals invite you to join them for conversation and light refreshments. The Editors will be available to answer questions, hear your ideas, and discuss any comments about the journals. All are welcome. We hope you will be able to join us.

OSA Science Educators' Day (EDAY)

Wednesday, 21 October, 17:00–20:00 Regency 1

This annual event focuses on effective and innovative approaches to science education, with an emphasis on hands-on, interactive classroom lessons.

Interactive Teaching and Peer Instruction, Eric Mazur; *Harvard University, USA*

Eric Mazur is the Balkanski Professor of Physics and Applied Physics at Harvard University and Area Dean of Applied Physics. An internationally recognized scientist and researcher, he leads a vigorous research program in optical physics and supervises one of the largest research groups in the Physics Department at Harvard University. Mazur founded several companies and plays an active role in industry.

In addition to his work in optical physics, Mazur has been very active in education. In 1990 he began developing Peer Instruction, a method for teaching large lecture classes interactively. He is the author of *Peer Instruction: A User's Manual* (Prentice Hall, 1997), a book that explains how to teach large lecture classes interactively. In 2006 he helped produce the award-winning DVD *Interactive Teaching*. Dr. Mazur's teaching method has developed a large following, both nationally and internationally, and has been adopted across many disciplines. Dr. Mazur has received numerous awards, including the Esther Hoffman Beller award from the Optical Society (OSA) and the Millikan Medal from the American Association of Physics Teachers (AAPT). In 2014 Mazur became the inaugural recipient of the Minerva Prize for Advancements in Higher Education. He is Fellow of the Optical Society (OSA) and Fellow of the American Physical Society (APS). He is a Member of the Royal Academy of Sciences of the Netherlands and a Member of the Royal Holland Society of Sciences and Humanities.

Dr. Mazur is author or co-author of 298 scientific publications, 36 patents, and several books, including the Principles and Practice of Physics (Pearson, 2014), a book that presents a groundbreaking new approach to teaching introductory calculus-based physics. Mazur is a sought-after speaker on optics and on education.

Optical Fabrication and Testing Technical Group Networking Event

Wednesday, 21 October, 18:00–20:00 Fairfield Room, The Fairmont San Jose

Join members of the Optical Fabrication and Testing Technical Group for a chance to learn more about this group and connect with fellow attendees who share an interest in optical fabrication and testing.

SA Technical Groups Sponsored by

OIDA Town Hall Forum on Biophotonics Challenges & Opportunities

Wednesday, 21 October, 18:00–20:00 Club Regent, Lobby Level



New! You're Invited to OSA's Free Town Hall Forum on Biophotonics

Please join us for an open town-hall meeting, where thought leaders debate and share perspectives that are critical to understanding the rapidly expanding biophotonics market. Questions to be discussed include:

- What is the enabling technology that has the most market traction?
- What are the challenges and opportunities among photonics technologies today?
- Where is the best potential for funding?

This event's new, interactive format will prioritize key findings for future use by the community. Happy hour drinks and snacks are complimentary.

FiO Postdeadline Paper Presentations

Wednesday, 21 October, 20:00–22:00 See the Update Sheet in your registration bag for exact times and locations

The FiO 2015 Technical Program Committee accepted a limited number of postdeadline papers for presentation. The purpose of postdeadline sessions is to give participants the opportunity to hear new and significant material in rapidly advancing areas. Only those papers judged to be truly excellent and compelling in their timeliness were accepted.

Exhibition Information

Visit the Frontiers in Optics 2015 Exhibit in the **Imperial Ballroom** and get a glimpse of the latest optical innovations! The FiO 2015 exhibit floor will feature companies representing a broad range of the best products and applications in the optics and photonics industry. Don't miss this opportunity to learn about new products, find technical and business solutions and gain the most up-to-date market perspective of your industry.

There is no charge to attend the exhibit—it's open to all registered attendees!

Exhibit Hours

Tuesday, 20 October	09:30–16:00
Wednesday, 21 October	09:30–14:00

Exhibit Hall Unopposed Exhibit-Only Times

Tuesday, 20 October	09:30–10:30 12:00–13:00 14:30–16:00
Wednesday, 21 October	09:30–11:00 12:30–13:30

Joint FiO/LS Poster Sessions

Imperial Ballroom

Poster presentations offer an effective way to communicate new research findings and provide an opportunity for lively and detailed discussion between presenters and interested viewers. Make sure to visit the poster sessions in the Exhibit Hall to see the more than 80 posters scheduled for presentation.

Tuesday, 20 October	14:30–16:00
Wednesday, 21 October	09:30-11:00

Exhibitor Appreciation Reception

Tuesday, 20 October, 16:00–17:00 Imperial Ballroom





Exhibitors, finish up your first day and come relax and mingle with your fellow exhibitors. Join us in the exhibit hall immediately following the close of the show for some food and beverages sponsored by OSA Industry Development Associates. Join OSA and discover the benefits of Industry Membership. OSA can help corporations optimize product development resources and reduce time to market by giving professionals access to quality information, quality interactions and premium opportunities for collaboration. Join today! Contact industry@osa.org or (202) 416-1482 for more information.

FiO 2015 Participating Companies:

(as of 09/22/2015)

AIP Publishing

American Association of Physics Teachers American Elements American Institute of Physics Cambridge University Press Chroma Technology Corp. Energetiq Technology, Inc. Fianium, Inc. **IDEX Optics & Photonics** Inrad Optics Jasper Display Corp. **KMLabs** LEUKOS Light Brigade, Inc., The Liquid Instruments Mahr-ESDI Newport Corporation NKT Photonics Inc. **Ophir-Spiricon**, LLC Optimax Systems, Inc. Optromix, Inc. **OSA Industry Development Associates** PHASICS Corp. Pure Photonics Santec USA Corporation SPIE Steinmeyer, Inc. Syntec Optics Thorlabs Toptica Photonics, Inc. TRIOPTICS USA University of Arizona, College of Optical Sciences

FiO/LS Committee

Thanks to the technical program committee members! Your time and efforts are appreciated!

Frontiers in Optics 2015 Technical Program Committee

David Hagan, Univ. of Central Florida, CREOL, USA, General Chair Nikola Alic, Univ. of California at San Diego, USA, General Chair Nozomi Nishimura, Cornell Univ., USA, Program Chair Ronald Reano, Ohio State Univ., USA, Program Chair

FiO 1: Optical Design and Instrumentation

Ronguang Liang, Univ. of Arizona, USA,

Subcommittee Chair Michael Gehm, Duke Univ., USA John Koshel, Univ. of Arizona, USA Stephen Kuebler, Univ. of Central Florida, CREOL, USA

Byoungho Lee, Seoul Natl. Univ., Korea Yi-Hsin Lin, Natl. Chiao Tung Univ., Taiwan Jannick Rolland, Univ. of Rochester, USA Kevin Rolland-Thompson, Synopsys Inc, USA Qiwen Zhan, Univ. of Dayton, USA

FiO 2: Optical Sciences

Laszlo Veisz, Max Planck Inst. for Quantum Optics, Germany, Subcommittee Chair Selçuk Aktürk, Istanbul Technical Univ., Turkey Ian Coddington, Natl. Inst. of Standards and Technology, USA Cameron Geddes, LBL, USA Igor Jovanovic, Penn State Univ., USA Carlos Lopez Mariscal, Naval Research Lab, USA Rodrigo Lopez-Martens, École Natl. Supérieure de Techniques Avancées, France Stephen Maxwell, Natl. Inst. of Standards and Technology, USA Jie Qiao, Rochester Inst. of Technology, USA Koichi Yamakawa, Japan Atomic Energy Agency, Japan

FiO 3: Optics in Biology and Medicine

Melissa Skala, *Vanderbilt Univ., USA,* **Subcommittee Chair**

Steven Adie, Cornell Univ., USA J. Quincy Brown, Tulane Univ., USA Alvara Casas-Bedoya, Univ. of Sydney, Australia Bernard Choi, Univ. of California at Irvine, USA Conor Evans, Massachusetts General Hospital, USA Martin Leahy, Natl. Univ. of Ireland Galway, Ireland Aydogan Ozcan, Univ. of California at Los Angeles, USA Alvin Yeh, Texas A&M Univ., USA

FiO 4: Fiber Optics and Optical Communications

John Marciante, Univ. of Rochester, USA,

Subcommittee Chair

John Ballato, Clemson Univ., USA Mikhail Brodsky, ATT Research, USA Iyad Dajani, Air Force Research Lab., USA Fabrizio Di Pasquale, Scuola Superiore Sant'Anna, Pisa, Italy Goëry Genty, Univ. of Tempere, Finland Morten Ibsen, Univ. of Southampton, UK Bill Kuo, Univ. of California at San Diego, USA Thomas Murphy, Univ. of Maryland, USA Chongjin Xie, Alcatel-Lucent Labs, USA

FiO 5: Integrated Photonics

Joyce Poon, Univ. of Toronto, Canada, Subcommittee Chair

Paul Barclay, Univ. of Calgary, Canada Badhise Ben Bakir, CEA-Leti, France Ivan Biaggio, Lehigh Univ., USA Nicolas Fang, Massachusetts Inst. of Technology, USA William Green, IBM T. J. Watson Research Ctr., USA Wataru Nakagawa, Montana State Univ., USA Nicolae-Coriolan Panoiu, Univ. College London, UK Mahmoud Rasras, Masdar Inst., United Arab Emirates Lin Zhu, Clemson Univ., USA

FiO 6: Quantum Electronics

Alexander V. Sergienko, Boston Univ., USA, Subcommittee Chair Ryan Camacho, Sandia Natl. Lab, USA Hui Cao, Yale Univ., USA Luca Dal Negro, Boston Univ., USA Sara Ducci, Univ. of Paris VII, France Jim Franson, Univ. of Maryland Baltimore County, USA Yuri Kivshar, Australian Natl. Univ., Australia John Rarity, Univ. of Bristol, UK Fabio Sciarrino, Univ. of Rome La Sapienza, Italy Duncan Steel, Univ. of Calgary, USA Rupert Ursin, Univ. of Vienna, Austria

FiO 7: Vision and Color

Brian Vohnsen, Univ. College Dublin, Ireland, Subcommittee Chair

Stacey Choi, Ohio State Univ., USA Enrique-Josua Fernandez, Univ. de Murcia, Spain Ravi Jonnal, Univ. of California at Davis, USA Andrew Metha, Univ. of Melbourne, Australia Ramkumar Sabesan, Univ. of California at Berkeley, USA

Yuhua Zhang, Univ. of Alabama at Birmingham, USA

Laser Science Program Committee

Galina Khitrova, College of Optical Sciences, Univ. of Arizona, USA, **General Chair** Randy A. Bartels, Colorado State Univ., USA, **Program Chair**

Laser Science Session Organizers

Accelerating Beams in Optics and Beyond Ido Kaminer, Technion Isreal Inst. of Technology, Israel

Innovative Metallic-Emitter Coupled Systems Josh Hendrickson, Wright-Patterson Air Force Base, USA

Semiconductor Nanooptics Sangam Chatterjee, Philipps Univ. Marburg, Germany

Novel Fiber Lasers Nasser Peyghambarian, Univ. of Arizona, USA

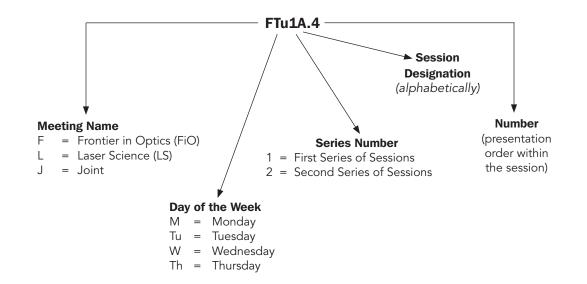
Computational Optical Imaging Lei Tian, Univ. of California at Berkeley, USA

Advances in Nonlinear Laser Spectroscopy Jesse Wilson, Duke Univ., USA

Precision Laser Spectroscopy Dylan Yost, Univ. of Colorado at Boulder, JILA, USA

Light Propagation in Scattering Media Jeff Field, Colorado State Univ., USA

Explanation of Session Codes



The first letter of the code designates the meeting (For instance, F = Frontiers in Optics, L = Laser Science, J=Joint). The second element denotes the day of the week (Monday = M, Tuesday = Tu, Wednesday = W, Thursday = Th). The third element indicates the session series in that day (for instance, 1 would denote the first parallel sessions in that day). Each day begins with the letter A in the fourth element and continues alphabetically through a series of parallel sessions. The lettering then restarts with each new series. The number on the end of the code (separated from the session code with a period) signals the position of the talk within the session (first, second, third, etc.). For example, a presentation coded FW1A.4 indicates that this paper is part of the Frontiers in Optics Meeting and is being presented on Wednesday (W) in the first series of sessions (1), and is the first parallel session (A) in that series and the fourth paper (4) presented in that session.

Agenda of Sessions - Sunday, 18 October

07:00–17:00	OSA Annual Student Chapter Leadership Conference (Invitation Only), Hyatt Place San Jose, Grand Hall
12:00-16:00	CAM Lounge, Market Street Foyer
12:00–18:30	Registration, Market Street Foyer
16:30–18:30	FS1A • Townes Memorial Symposium, Regency Ballroom
18:30–20:00	Townes Memorial Reception, Club Regent, Lobby Level (Sponsored by Thorlabs)
19:00-22:00	OSA Student Member Reception, Da Kine Island Grill, 23 N. Market St., San Jose, CA

Monday, 19 October

	California	Valley	Crystal	Gold	Empire	
07:00-18:00	Registration, Market Street Foyer					
08:00–10:00	FM1A • Laser-plasma-based Secondary Sources I	FM1B • Integrated Plasmonics	FM1C • Symposium on Photoreceptor Analysis and Single-cone- mediated Vision	FM1D • Nonlinear Optics in Micro or Nano-Optical Structures I 💽	FM1E • Emerging Technologies for High Speed Optical Communications I	
09:00-16:00			CAM Lounge, Market Street Foye	er		
10:00-10:30		Coff	ee Break, Market Street & South Tow	ver Foyers		
10:30–12:00	FM2A • Laser-plasma-based Secondary Sources II	FM2B • Biophotonics for Point-of-Care and Global Health Applications	FM2C • Novel Methods for Tissue Imaging and Therapy	FM2D • Nonlinear Optics in Micro or Nano-Optical Structures II	FM2E • Emerging Technologies for High Speed Optical Communications II	
12:00-13:30			Lunch (on your own)		· · ·	
12:00-13:30		Frontiers	in Photonic Detection Panel Discuss	sion, Belvedere		
12:00-13:30		Nonline	ear Optics Technical Group Worksho	op, Atherton		
12:00-13:30	OSA Fello	w Members Lunch (Advance reg	istration required), Ballroom, The We	stin San Jose, 302 S. Market Stree	et, San Jose, CA	
13:30–15:30	FM3A • Laser-plasma-based Secondary Sources III	FM3B • Plasmonics and Nanophotonics ()	FM3C • Symposium on Optics for Global Health and Low Resource Settings	FM3D • Nonlinear Optics in Micro or Nano-Optical Structures III	FM3E • Optical Design (ends at 15:15)	
15:30–16:00	Coffee Break, Market Street & South Tower Foyers					
16:00–18:00	FM4A • International Year of Light – Science to Solutions Special Session, Regency Ballroom					
18:00–19:00	OSA Microscopy and Optical Coherence Tomography Technical Group Poster Session, Atherton					
18:00–19:00	Meet OSA's Journal Editors, Club Regent, Lobby Level					
18:30–20:30	International Year of Light/OSA President's Reception, City Hall Rotunda, 200 E. Santa Clara Street, San Jose, CA					

All sessions/events to be held at The Fairmont San Jose unless otherwise noted.

Key to Shading



Laser Science

Joint

Fairfield	Sacramento	Hillsborough	Piedmont	Glen Ellen
		Registration, Market Street Foyer	1	1
FM1F • Novel Concepts in Waveguide Optics (ends at 09:30)	FM1G • Optical Fabrication and Testing	LM1H • Carl E. Anderson Award for Outstanding Doctoral Dissertation in Laser Science	LM1I • Nonlinear and Spectroscopic Imaging I	
		CAM Lounge, Market Street Foyer	-	
	Coffee Break, Market	Street & South Tower Foyers		Laser Science Symposium on
FM2F • Advances in Ocular Biometry and Studies of the Anterior Eye	FM2G • Optical Metrology (begins at 11:00)	LM2H • Computational Optical Imaging I	LM2I • Accelerating Wavepackets in Optics and Beyond I	Undergraduate Research (See program distributed with registration materials
	Lunch (on your own)		for complete information)
	Frontiers in Photonic Detec	tion Panel Discussion, Belvedere		10:00-12:30 LM2J • Laser Science Symposium on Undergraduate Research Poster Session 12:30–14:00 LM3J • Laser
	Nonlinear Optics Technic	cal Group Workshop, Atherton		
OSA Fellow Members L	unch (Advance registration required),	Ballroom, The Westin San Jose, 302 S.	Market Street, San Jose, CA	
FM3F • Retinal Imaging, Vasculature, and Photoreceptor Modelling in Healthy and Diseased Eyes	FM3G • Novel Materials and Design for Optical Fibers	LM3H • Semiconductor NanoOptics I (ends at 15:45)	LM3I • Accelerating Wavepackets in Optics and Beyond II	Science Symposium on Undergraduate Research I 14:00–16:00 LM4J • Laser Science Symposium on Undergraduate Research II
	Cof	fee Break, Market Street & South Tower	Foyers	
		r of Light – Science to Solutions Speci	* /	
		cal Coherence Tomography Technical C	•	
		OSA's Journal Editors, Club Regent, Lo		
	International Year of Light/OSA Pr	esident's Reception, City Hall Rotunda,	200 E. Santa Clara Street, San Jose, C.	A

Agenda of Sessions - Tuesday, 20 October

	California	Valley	Crystal	Gold		
07:00-18:00	Registration, Market Street Foyer					
08:00–09:30	JTu1A • Joint FiO/LS Plenary and Awards Session I, Regency Ballroom					
09:00–16:00		CAM Lounge, N	larket Street Foyer			
09:30–16:00			n, Imperial Ballroom Ceremony at 09:30			
09:30–10:30			e, Exhibit Hall, Imperial Ballroom : (09:30-10:00)			
10:30–12:00	FTu2A • Integrated Quantum Optics I	FTu2B • Photonic Crystals 🔹	FTu2C • Wearable Imaging Optics D	FTu2D • Microscopy I 🔹		
12:00–13:00	Lun	 ch Break (on your own) and Unopposed Ex	 shibit Only Time, Exhibit Hall, Imperial Ballı	room		
12:00–13:30		Optical Material Studies Techn	ical Group Workshop, Cupertino			
12:00–13:30		Better than Fakin' it Good: Mult	ifunctional Bioreplication, Fairfield			
14:30–16:00		OSA Student Chapter Competit	ion, Exhibit Hall, Imperial Ballroom			
13:00–14:30	FTu3A • Nonlinear Optics in Micro or Nano-Optical Structures IV	FTu3B • Novel Communications Technologies	FTu3C • Photonic Structures for Energy	FTu3D • Microscopy II 🜔		
14:30–16:00		JTu4A • Joint FiO/LS Poster Sess	ion I, Exhibit Hall, Imperial Ballroom			
14:30–16:00			e, Exhibit Hall, Imperial Ballroom ; (14:30-15:00)			
16:00–18:00	FTu5A • Nonlinear Optics in Micro or Nano-Optical Structures V	FTu5B • Studying Human Vision with Animal Eyes and Exploring the Limits of Human Vision 🕥	FTu5C • Optomechanics and Photonic Nanostructures	FTu5D • Wavefront Sensing and Adaptive Optics		
16:00–17:00	Exhibitor Appreciation R	eception (exhibitors only Sponsored by C	SA Industry Development Associates, Ext	nibit Hall, Imperial Ballroom		
16:00–17:00	Minorities and Women in OSA (MWOSA) Networking Reception, Atherton					
17:00–17:45	OSA Annual Business Meeting, Fairfield					
17:00–18:00	APS Division of Laser Science Annual Business Meeting, Belvedere					
18:30–20:30	OSA N	lember Reception, Grande Ballroom, The N	Vestin San Jose, 302 S. Market Street, San .	lose, CA		
19:00–22:00	Laser Science Banquet, Gordon Biersch, 33 East San Fernando St, San Jose, CA					

All sessions/events to be held at The Fairmont San Jose unless otherwise noted.

Key to Shading



Empire	Glen Ellen	Sacramento	Hillsborough	Piedmont
		Registration, Market Street Foyer		
	JTu1A • Joint Fi	O/LS Plenary and Awards Session I, /	Regency Ballroom	
		CAM Lounge, Market Street Foyer		
		Exhibit Hall Open, Imperial Ballroom Ribbon Cutting Ceremony at 09:30		
	Unopposed	Exhibit Only Time, Exhibit Hall, Impe Coffee Break (09:30-10:00)	erial Ballroom	
FTu2E • Engineered Frequency Combs in Passive and Active Systems I		FTu2F • General Quantum Electronics I	LTu2G • Precision Laser Spectroscopy I	LTu2H • Novel Fiber Lasers I
	Lunch Break (on your own) a	and Unopposed Exhibit Only Time, E	xhibit Hall, Imperial Ballroom	
	Optical Mate	rial Studies Technical Group Worksh	op, Cupertino	
	Better than Fa	kin' it Good: Multifunctional Biorepli	i cation, Fairfield	
	OSA Student	Chapter Competition, Exhibit Hall, Im	perial Ballroom	
FTu3E • Engineered Frequency Combs in Passive and Active Systems II 🕥	FTu3F • Lasers and Electro-optics	FTu3G • General Quantum Electronics II	LTu3H • Nonlinear and Spectroscopic Imaging II	LTu3I • Novel Fiber Lasers II
	JTu4A • Joint F	iO/LS Poster Session I, Exhibit Hall, I	mperial Ballroom	1
	Unopposed	Exhibit Only Time, Exhibit Hall, Impe Coffee Break (14:30-15:00)	erial Ballroom	
FTu5E • Laser-matter Interaction 🜔		FTu5F • Optical Trapping and Manipulation	LTu5G • Precision Laser Spectroscopy II	LTu5H • Novel Fiber Lasers III
Exhibitor A	ppreciation Reception (exhibitors on	y) Sponsored by OSA Industry Devel	opment Associates, Exhibit Hall, Imp	erial Ballroom
	Minorities and Wo	men in OSA (MWOSA) Networking F	Reception, Atherton	
	C	DSA Annual Business Meeting , Fairfie	ld	
	APS Division o	f Laser Science Annual Business Mee	eting, Belvedere	
	OSA Member Reception, Gran	de Ballroom, The Westin San Jose, 30	2 S. Market Street, San Jose, CA	
	Laser Science Banqu	iet, Gordon Biersch, 33 East San Ferna	ando St, San Jose, CA	

Agenda of Sessions – Wednesday, 21 October

	California	Valley	Crystal	Gold		
07:00–18:00	Registration, Market Street Foyer					
08:00–09:30		JW1A • Joint FiO/LS Plenary and	Awards Session II, Regency Ballroom			
09:00–16:00		CAM Lounge, N	1arket Street Foyer			
09:30–14:00		Exhibit Hall Open, Exhi	bit Hall, Imperial Ballroom			
09:30–11:00		JW2A • Joint FiO/LS Poster Sess	ion II, Exhibit Hall, Imperial Ballroom			
09:30–11:00			e, Exhibit Hall, Imperial Ballroom nsored by IDEX Optics & Photonics			
10:00-12:15	OSA Friends and Family To	ur of Rosicrucian Egyptian Museum and F	Planetarium (Bus departs from Fairmont San	Jose's main entrace at 10:15)		
11:00–12:30	FW3A • General Optical Sciences I	FW3B • Integrated Photonics for Communications: Datacenters and Networks I	FW3C • Frequency Comb Generation and Applications	FW3D • Quantum Optical Measurement and Technologies I 🔹		
12:30–13:30	Lun	ch Break (on your own) and Unopposed E	xhibit Only Time, Exhibit Hall, Imperial Ballr	room		
12:30–14:00		VIP Industry Leaders Networkin	g Event, Club Regent, Lobby Level			
13:00–14:30		Meet the Editors of the APS Jou	rnals, Exhibit Hall, Imperial Ballroom			
13:30–15:30	FW4A • General Optical Sciences II	FW4B • Integrated Photonics for Communications: Datacenters and Networks II	FW4C • Symposium on Optical Remote Sensing for the Climate (ends at 15:00)	FW4D • Quantum Optical Measurement and Technologies II 🔹		
15:30–16:00		Coffee Break, Market St	treet & South Tower Foyers			
16:00–18:00	FW5A • Quantum Optical Measurement and Technologies III	FW5B • Integrated Photonics for Communications: InP Platforms and Lasers (ends at 17:30)	FW5C • Novel Concepts in Plasmonics O	FW5D • Polarization Imaging D		
17:00-20:00	OSA Science Educators' Day, Regency Ballroom I					
18:00-20:00	Optical Fabrication and Testing Technical Group Networking Event, Fairfield					
18:00–20:00	OIDA Town Hall Forum on Biophotonics Challenges & Opportunities, Club Regent, Lobby Level					
20:00–22:00		FiO Postdeadline Paper Session The complete schedule can be found in the PDP program and the FiO Mobile App.				

All sessions/events to be held at The Fairmont San Jose unless otherwise noted.

Key to Shading



Laser Science

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Empire	Glen Ellen	Sacramento	Hillsborough	Piedmont		
Registration, Market Street Foyer						
	JW1A • Joint Fi	O/LS Plenary and Awards Session II,	Regency Ballroom			
		CAM Lounge, Market Street Foyer				
	Exhib	it Hall Open, Exhibit Hall, Imperial Ba	llroom			
	JW2A • Joint F	iO/LS Poster Session II, Exhibit Hall, I	mperial Ballroom			
		Exhibit Only Time, Exhibit Hall, Impe 99:30–10:00) Sponsored by IDEX Op				
OSA Friends	and Family Tour of Rosicrucian Egypti	an Museum and Planetarium (Bus de	parts from Fairmont San Jose's main e	ntrace at 10:15)		
FW3E • Novel Integrated Optical Structures	FW3F • Novel Light Generation and Manipulation in Fiber Devices I	FW3G • Symposium Honoring Adolf Lohmann I	LW3H • Novel Photonics (ends at 12:45)	LW3I • Computational Optical Imaging II		
	Lunch Break (on your own) a	and Unopposed Exhibit Only Time, E	xhibit Hall, Imperial Ballroom			
	VIP Industry Le	eaders Networking Event, Club Rege	ent, Lobby Level			
	Meet the Edito	rs of the APS Journals, Exhibit Hall, Ii	mperial Ballroom			
FW4E • Optical Coherence Tomography	FW4F • Novel Light Generation and Manipulation in Fiber Devices II	FW4G • Symposium Honoring Adolf Lohmann II	LW4H • Semiconductor NanoOptics II	LW4I • Advanced Imaging		
	Coffee	e Break, Market Street & South Tower	Foyers			
FW5E • General Optics in Biology and Medicine D	FW5F • Novel Light Generation and Manipulation in Fiber Devices III	FW5G • Symposium Honoring Adolf Lohmann III (ends at 18:15)	LW5H • Semiconductor NanoOptics III (starts at 16:30)	LW5I • Precision Laser Spectroscopy III		
	OSA	Science Educators' Day, Regency Ball	lroom l			
	Optical Fabrication	and Testing Technical Group Netwo	rking Event, Fairfield			
	OIDA Town Hall Forum on Bi	ophotonics Challenges & Opportuni	ties, Club Regent, Lobby Level			
	The complete schedul	FiO Postdeadline Paper Session the can be found in the PDP program an	nd the FiO Mobile App.			

Agenda of Sessions - Thursday, 22 October

	California	Valley	Crystal	Gold	
07:30–17:30		Registration, M	arket Street Foyer	·	
08:00–10:00	FTh1A • General Optical Sciences III	FTh1B • Light Manipulation in Plasmonic Structures O	FTh1C • Coherence, Interference and General Optics I	FTh1D • Integrated Quantum Optics II	
10:00–10:30		Coffee Break, Market St	reet & South Tower Foyers		
10:30–12:00	FTh2A • General Optical Sciences IV	FTh2B • Photonics on Silicon D	FTh2C • Coherence, Interference, and General Optics - II (begins at 10:45)	FTh2D • Quantum Communications I	
12:00–13:00		Lunch (or	n your own)		
13:00–15:00	FTh3A • Ultrafast Laser Applications I	FTh3B • Integrated Photonics for Communications: Hybrid Integration on Silicon I	FTh3C • Symposium on Applications of Low Noise Frequency Combs I	FTh3D • Quantum Communications II	
15:00–15:30	Coffee Break, Market Street & South Tower Foyers				
15:30–17:30	FTh4A • Ultrafast Laser Applications II	FTh4B • Integrated Photonics for Communications: Hybrid Integration on Silicon II •	FTh4C • Symposium on Applications of Low Noise Frequency Combs II 🔹	LTh4D • Complex Dynamics (ends at 17:15)	

All sessions/events to be held at The Fairmont San Jose unless otherwise noted.

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Empire	Glen Ellen	Sacramento	Hillsborough	Piedmont			
	Registration, Market Street Foyer						
FTh1E • Optical Fiber Sensors I: Applications	FTh1F • Computational Optical Sensing and Imaging	FTh1G • Optics and Photonics of Disordered Systems I	LTh1H • Complex Wave Propagation	LTh11 • Innovative Metallic- Emitter Coupled Systems I			
	Coffe	e Break, Market Street & South Tower	Foyers				
FTh2E • Optical Fiber Sensors II: Biosensors 🕥	FTh2F • High Power Raman Fiber Lasers	FTh2G • Optics and Photonics of Disordered Systems II	LTh2H • Light Propagation in Scattering Media	LTh2I • Innovative Metallic- Emitter Coupled Systems II			
		Lunch (on your own)	1	1			
FTh3E • Optical Fiber Sensors III: Devices O	FTh3F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning I	FTh3G • Computational Optical Sensing and Imaging II	FTh3H • Fiber Lasers and Amplifiers	LTh3I • Innovative Metallic- Emitter Coupled Systems III			
Coffee Break, Market Street & South Tower Foyers							
FTh4E • Optical Fiber Sensors IV: Methods	FTh4F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning II	FTh4G • Computational Optical Sensing and Imaging III	LTh4H • Stable Laser Systems	LTh4I • Novel Laser Systems			

California Valley Crystal Gold Empire FiO 07:00–18:00 Registration, Market Street Foyer 08:00-10:00 08:00-09:45 08:00-10:00 08:00-10:00 08:00-10:00 FM1A • Laser-plasma-based FM1B • Integrated FM1C • Symposium on FM1D • Nonlinear Optics in Micro FM1E • Emerging Technologies Plasmonics **D** or Nano-Optical Structures I Secondary Sources I Photoreceptor Analysis and for High Speed Optical Presider: Andrew White: Univ. of Communications | Presider: Laszlo Veisz: Max-Planck-Presider: Ivan Biaggio; Lehigh Single-cone-mediated Vision **D** Institut fur Quantenoptik, Germany Univ., USA Presider: Ann Elsner; Indiana Univ., Queensland, Australia Presider: Alexei Pilipetskii; TE USA SubCom, USA FM1A.1 • 08:00 Invited FM1B.1 • 08:00 FM1C.1 • 08:00 Invited WiO FM1D.1 • 08:00 Invited FM1E.1 • 08:00 Multi-GeV Electron Beams at the Berkeley Fabrication and Optical Transmission Prop-Human Photoreceptor Topography - 25 years Nonlinear Silicon Photonics, Martino Bernard², Multicore Space Division Multiplexed Un-Lab Laser Accelerator, Anthony J. Gonsalves¹, erties of ZnO Nanowire Waveguide Arrays, and Looking Ahead, Christine A. Curcio¹; ¹Univ. Massimo Borghi¹, Mher Ghulinyan², Santanu repeatered Transmission beyond 100-Tb/s

Lab Laser Accelerator, Anthony J. Gonsalves¹, Kei Nakamura¹, Joost Daniels^{1,2}, Hann-Shin Mao¹, Carlo Benedetti¹, Carl Schroeder¹, Csaba Toth¹, Jeroen Van Tilborg¹, Daniel Mittelberger¹, Stepan Bulanov^{1,3}, Jean-Luc Vay¹, Cameron G. Geddes¹, Eric Esarey¹, Wim P. Leemans^{1,3}; ¹ATAP, Lawrence Berkeley National Lab, USA; ²Univ. of Technology Eindhoven, Netherlands; ³Univ. of California Berkeley, USA. Multi-GeV electron beams from nonlinear laser-plasma acceleration were achieved in cm-scale plasma waveguides. Self-focusing caused trapping in multiple plasma periods. These processes are strongly parameter dependent, requiring precise plasma control for stable acceleration. Fabrication and Optical Transmission Properties of ZnO Nanowire Waveguide Arrays, Huizhong Xu¹, Thomas Lamson¹, Sahar Khan¹, Orlando Lopez¹, Shadab Hassan¹, Charles Kim¹; ¹St. John's Univ., USA. We demonstrate the fabrication of ZnO nanowire arrays of controlled diameter and spacing and show that strong resonant transmission of visible light through ZnO nanowaveguide arrays in a silver film can be achieved. FM1C.1 • 08:00 Invited O WiO Human Photoreceptor Topography - 25 years and Looking Ahead, Christine A. Curcio'; 'Univ. of Alabama at Birmingham, USA. A comprehensive map of photoreceptors in human retinas enabled visualization and quantification of vision's initial sampling array, informing today's in vivo imaging techniques with sub-cellular resolution and mechanistic approaches to retinal pathology.

Nonlinear Silicon Photonics, Martino Bernard², Massimo Borghi¹, Mher Ghulinyan², Santanu Manna¹, Mattia Mancinelli¹, Georg Pucker², Fernando Ramiro Manzano¹, Alessandro Trenti¹, Lorenzo Pavesi¹; 'Universita degli Studi di Trento, Italy: ²Centro Materiali e Microsistemi, Bruno Kessler Foundation, Italy. The nonlinear optical properties of silicon based whispering gallery resonators are here presented. Silicon as well as silicon nitride and silicon nanocrystals based optical microresonators where third order and second order nonlinearities are evidenced have been studied. Multicore Space Division Multiplexed Unrepeatered Transmission beyond 100-Th/s Capacity, Hidehiko Takara¹, T. Mizuno¹, Yoko Miyamoto¹, ¹NTT Network Innovation Labs, Japan. The paper describes high capacity unrepeatered transmission using multicore-fiber-based remote optically-pumped amplifier. Recent development on transmission technologies based on multicore space-division-multiplexing is also reviewed.

FM1B.2 • 08:15 Silicon Nanoparticles for Waveguiding, Reuben M. Bakker', Ye Feng Yu', Ramón Paniagua-Domínguez', Boris Luk'yanchuk', Arseniy Kuznetsov'; 'Data Storage Inst., Singapore. Guiding of photon energy on the subwavelength scale has long been a goal of the nanophotonics community. We present experimental results on guiding visible light using silicon nanoparticles with losses as low

as 2.5dB/100 micrometers.



Fairfield	Sacramento	Hillsborough	Piedmont
F	iO	L	S
	07:00–18:00 Registra	tion, Market Street Foyer	
08:00–09:30 FM1F • Novel Concepts in Waveguide Optics O Presider: Tsung-Han Tsai, National Taiwan Univ., Taiwan	08:00–09:45 FM1G • Optical Fabrication and Testing Presider: Rongguang Liang; Univ. of Arizona, USA	08:00-10:00 LM1H • Carl E. Anderson Award for Outstanding Doctoral Dissertation in Laser Science Presider: Kristan Corwin; Kansas State Univ., USA	08:00–10:00 LM11 • Nonlinear and Spectroscopic Imaging I Presider: Marcus Cicerone; NIST, USA
FM1F.1 • 08:00 Coupling Length Phase Matching in Parallel Waveguides, Ivan Biaggio ¹ , Virginie Coda ² , Germano Montemezzani ² ; ¹ Le- high Univ., USA; ² Lab LMOPS, Univ. of Lorraine and Supelec, France. We show that phase-matching for frequency conver- sion is possible in a system consisting of two parallel wave- guides without any spatial modulation of linear or nonlinear optical properties, both for second and for third-order effects.	FMIG.1 • 08:00 Invited Manufacturing of Low Cost Precision 3D Micro Optics, Hui Li', Neil Naples', Allen Y. Yi'; 'Ohio State Univ., USA. Conventional lithography based micromachining methods often involves in complex facilities, templates and repeated mechanical alignments. In a departure from cleanroom based process, we aimed to establish a cost-effective, high preci- sion, true 3D micromachining method with high flexibility.	LM1H.1 • 08:00 Spawning Rings of Exceptional Points out of Dirac Cones, Bo Zhen ^{1,2} , Chia Wei Hsu ^{3,1} , Yuichi Igarashi ⁴ , Ling Lu ¹ , Ido Kaminer ^{1,2} , Adi Pick ⁵ , Song-Liang Chua ⁴ , John Joannopou- los ¹ , Marin Soljacic ¹ ; ¹ MIT, USA; ² Technion, Israel; ³ Yale Univ., USA; ⁴ NEC, Japan; ⁵ Harvard Univ., USA; ⁴ OSO National Labs, Singapore. We demonstrate that an accidental Dirac cone can evolve into a ring of exceptional points in a photonic crystal slab. Radiation fundamentally changes the band structure even though there is no material loss or gain.	LM11.1 • 08:00 Invited Enhancing Pigmented or Transparent Tissue Imaging w Laser Pulse Shaping, Warren S. Warren ¹ , Martin C. Fische Francisco E. Robles ¹ , Jesse Wilson ¹ , Sanghamitra Deb ¹ ; ¹ Du Univ., USA. Enhanced control over femtosecond lasers (pu shaping or pulse train modulation) improves contrast in tiss imaging. Pump-probe applications to melanoma diagno and cross phase modulation measurement in transpare tissues will be presented.
FM1F.2 • 08:15 Coupling Length Phase Matching for Third-Order Fre- quency Downconversion in Dual Core Fibers, Ivan Biaggio ¹ , Virginie Coda ² , Germano Montemezzani ² ; ¹ Lehigh Univ., USA; ² Lab LMOPS, Univ. of Lorraine and Supelec, France. The coupling between parallel waveguides leads to a quasi-phase matching effect that allows to obtain phase matching for			

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third-order down conversion and other third-order processes in silica fibers. Several phase matching conditions are found.

California Valley Gold Empire Crystal FiO FM1A • Laser-plasma-based FM1B • Integrated FM1C • Symposium on FM1D • Nonlinear Optics in Micro FM1E • Emerging Technologies for High Speed Optical Secondary Sources I—Continued Plasmonics—Continued Photoreceptor Analysis and or Nano-Optical Structures I-Communications I—Continued Single-cone-mediated Vision— Continued Continued FM1A.2 • 08:30 Invited FM1B.3 • 08:30 Invited WiO FM1C.2 • 08:30 Invited FM1D.2 • 08:30 FM1E.2 • 08:30 Generation of Sub-cycle Attosecond Pulses Practical Platform for Nanophotonics with Wavequide Properties of Cone Photorecep-Stabilized on-chip optical frequency comb, Comparison of Homogeneous and Heterofrom a Single Laser-driven Relativistic Electron tors, Donald T. Miller¹: ¹Indiana Univ., USA. Shu-Wei Huang¹, Jinghui Yang¹, Mingbin Yu², **Refractory Plasmonic Metal Nitrides and** geneous 2LP-mode Multicore Fibers for Sheet, Wenjun Ma¹, Jianhui Bin¹, Hongyong Transparent Conducting Oxides, Alexandra Dim-Lee Kwong², Chee Wei Wong¹; ¹UCLA, High Spatial Multiplicity, Yuki Tobita¹, Takeshi Photoreceptors waveguide light, but the extent Wang², Mark Yeung², Christian Kreuzer¹, Mat-Boltasseva¹; ¹Purdue Univ., USA. Advances to which they do remains controversial. We USA; ²The Inst. of Microelectronics, Singapore. Fujisawa¹, Kunimasa Saitoh¹, Shoichiro Matsuo², thew Streeter³, Peta Foster⁴, Steven Cousens⁵, in plasmonic materials, especially CMOSprovide new insight into the complexity of this We report the first stabilized CMOS-compatible Katsuhiro Takenaga²: ¹Hokkaido Univetsity. Brendan Dromey⁵, Xueging Yan⁶, Juergen compatible materials including transition metal process using AO-OCT to isolate reflections on-chip Kerr frequency comb at 220 mHz Japan; ²Fujikura Ltd., Japan. We compare ho-Meyer-ter-Vehn⁷, Matt Zepf^{2,5}, Jörg Schreiber^{1,7}; nitrides and transparent conducting oxides, that originate in the inner and outer segments. instability. The system is a promising compact mogeneous and heterogeneous 2LP-mode ¹Faculty of Physics, Ludwig-Maximilians U, enables a new generation of devices for applatform for coherent Raman spectroscopy, multicore fibers (MCFs) and find that the Germany; ²Helmholtz Inst. Jena, Germany; plications in on-chip optics, data storage, and coherent optical communication, optical arbiheterogeneous MCF can improve a tradeoff ³Blackett Lab, Imperial College London, UK; energy conversion. trary waveform generation, and astrophysical relationship between low inter-core crosstalk ⁴Central Laser Facility, STFC Rutherford Applespectrography. and short cutoff wavelength, resulting in high ton Lab, UK; ⁵Dept. of Physics and Astronomy, spatial multiplicity. Queen's Univ. Belfast, UK; 6State Key Lab of Nuclear Physics and Technology, Peking Univ., FM1D.3 • 08:45 FM1E.3 • 08:45 D China; 7Max-Planck-Inst. of Quantum Optics, Cavity-enhanced second harmonic generation Impulse Response Analysis of Strongly-Germany. Techniques that produce bright via topology optimization, Zin Lin¹, Xiangdong Coupled Three-Core Fibers, Takeshi Fujisawa¹, isolated attosecond pulses are very attractive Kunimasa Saitoh¹; ¹Hokkaido Univ., Japan. Liang², Marko Loncar¹, Steven Johnson², Alejanfor attosecond science. Here we report recent Impulse response of strongly-coupled 3-core dro Rodriguez3; 1Harvard Univ., USA; 2Matheexperimental results on generation of sub-cycle fibers is analyzed from weak to strong coupling matics Dept., MIT, USA; ³Electrical Engineering, attosecond pulses from a signle laser-driven Princeton Univ., USA. We describe a large-scale regime based on multimode generalized relativistic electron sheet. optimization approach that enables automatic nonlinear Schrödinger equation. Measured discovery of photonic structures for achieving and calculated impulse responses are in good high-efficiency second-harmonic generation. agreement, showing the validity of discussion. FM1A.3 • 09:00 WiO FM1C.3 • 09:00 Invited FM1B.4 • 09:00 FM1D.4 • 09:00 D FM1E.4 • 09:00 THz-Induced, High-Energy Electron Emission Fundamental Limits to Plasmonic Response, Single Cell Imaging In Photoreceptor De-Optomechanics of Random and Nonlinear Me-Design of Portable Multiplexer for Use with from Tungsten Nanotips, Sha Li¹, R.R. Jones¹; Owen Miller¹, Athanasios G. Polimeridis², M. T. generative Disease, Christopher Langlo¹, dia, Silvia Gentilini¹, Robert W. Boyd⁴, Claudio Spatial Domain Multiplexed Communication ¹Univ. of Virginia, USA. Single-cycle THz pulses H. Reid¹, Marin Soljacic³, Alejandro Rodriguez⁴, Alfredo Dubra^{3,2}, Joseph Carroll^{1,2}; ¹Cell Biology, Conti^{3,2}; ¹ISC-CNR, UOS Sapienza, Italy; ²Physics, Systems, Syed H. Murshid¹, Saud Alanzi¹, Bilas have been used to induce high energy (sev-Steven Johnson1; ¹Dept. of Mathematics, MIT, Neurobiology and Anatomy, Medical College Univ. "La Sapienza" of Rome, Italy; ³ISC-CNR, Chowdhury¹, Gregory Lovell¹, Rayan Enaya¹; eral keV) electron emission from nano-tipped USA; ²Skolkovo Inst. of Science and Technology, of Wisconsin, USA; ²Ophthalmology, Medical Italy; ⁴Physics, Univ. of Ottawa, Canada. We ¹Florida Inst. of Technology, USA. A portable tungsten wires. Comparison of the maximum College of Wisconsin, USA; ³Biophysics, Medi-Russia; ³Dept. of Physics, MIT, USA; ⁴Dept. of theoretically investigate the effects of randommultiplexer for use with spatially multiplexed opelectron energy as a function of tip radius and Electrical Engineering, Princeton Univ., USA. We cal College of Wisconsin, USA. Degenerative ness and nonlinearity on optical forces. Disorder tical fiber communications system is presented cone angle provides insight into the emission present fundamental limits to metallic (plasmonphotoreceptor disease represents a major enhances the light induced mechanical effects that utilizes multiple hollow core tubes at fixed

09:00-16:00 CAM Lounge, Market Street Foyer

cause of blindness, for which new therapies are

emerging. Here I discuss in vivo photoreceptor

imaging as it applies to disease monitoring and

tracking of therapeutic response.

and ultra-fast nonlinear polarization may give a

negative contribution to the optical pressure.

angles adding stability, reliability, robustness

and ease of use to spatial multiplexers.

mechanism and local electron-field interaction.

ic) response. Applied to radiative heat transfer,

our limits generalize the concept of a black body

to the near field, where we present designs that

may offer significant enhancements.

Monday, 19 October

Fairfield	Fairfield Sacramento		Piedmont
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FM1F • Novel Concepts in Waveguide Optics—Continued	FM1G • Optical Fabrication and Testing— Continued	LM1H • Carl E. Anderson Award for Outstanding Doctoral Dissertation in Laser Science—Continued	LM1I • Nonlinear and Spectroscopic Imaging I—Continued
FM1F.3 • 08:30 Phase-matched Second harmonic generation in 1D pho- tonic crystal in the Laue geometry, Vladimir B. Novikov ¹ , B. I. Mantsyzov ¹ , A. I. Maydykovskij ¹ , T. V. Murzina ¹ ; ¹ M. V. Lomonosov Moscow State Univ., Russia. Phase-matched second harmonic generation is observed experimentally in the Laue diffraction scheme in 1D porous quartz based photonic crystals infiltrated by a ferroelectric salt.	FM1G.2 • 08:30 Shape Adaptive Grinding of Silicon Carbide Aspheric Optic, Anthony Beaucamp ¹ , Yoshiharu Namba ² , Phillip Charlton ³ , Samyak Jain ³ ; ¹ Kyoto Univ, Japan; ² Chubu Univ, Japan; ³ Zeeko LTD, UK. Shape Adaptive Grinding (SAG) is a novel finishing process capable of achieving optical surface finish on silicon carbide. In this paper, we report on the ap- plication of SAG to grinding of aspheric optics.	LM1H.2 • 08:30 Helicity and Duality Symmetry in Light Matter Interac- tions: Theory and Applications, Ivan Fernandez-Corbaton ^{1,2} ; 'Macquarie Univ., Germany; ² Inst. of Nanotechnology, Karsl- ruhe Inst. of Technology, Germany. Treating polarization by means of the electromagnetic helicity leads to new insights in different problems: Optical activity, zero backscattering, metamaterials for transformation optics and nanophotonics phenomena involving angular momentum.	LM11.2 • 08:30 Invited WiO Mid-Infrared Photothermal Imaging, Michelle Y. Sander'; 'Electrical and Computer Engineering, Photonics Center, Division of Materials Science and Engineering, Boston Univ, USA. In photothermal imaging label-free characterization of molecular vibrational bonds is combined with spatial information. A mid-infrared photothermal system with high specificity and sensitivity using a near-infrared fiber and a tunable quantum cascade laser is presented.
FM1F.4 • 08:45 WIO A high-performance polarization splitter-rotator designed by wavefront matching method, Shuntaro Makino ¹ , Takeshi Fujisawa ¹ , Kunimasa Saitoh ¹ ; 'Hokkaido Univ., Japan. A high-performance polarization splitter-rotator based on a mode-conversion taper and a mode-sorting asymmetric Y-branch waveguides is designed by wavefront matching method. A high transmission in a wide wavelength range is demonstrated.	FM1G.3 • 08:45 WiO A surface profilometer based on laser confocal feedback, weiping wang ¹ , Shulian Zhang ¹ ; 'Dept. of Precision and Instru- ments, Tsinghua Univ., China. An optical surface profilometry method is developed based on microchip Nd:YVO ₄ laser feedback and confocal technologies.The signal is detected using heterodyne approach to ensure environmental robust- ness and invulnerability to the laser instability.		
FM1F.5 • 09:00 WiO Broadband LP ₀ ,/LP ₁ , PLC-based mode multi/demultiplexer designed by wavefront matching method, Yoko Yamashita ¹ , Shuntaro Makino ¹ , Takeshi Fujisawa ¹ , Kunimasa Saitoh ¹ , No- butomo Hanzawa ² , Taiji Sakamoto ² , Takashi Matsui ² , Kyozo Tsujikawa ² , Fumihiko Yamamoto ² , ¹ Hokkaido Univ., Japan; ² NTT Corporation, Japan. A broadband, large fabrication tolerance LP ₀ /LP ₁₁ PLC-based mode multi/demultiplexer design is presented by using wavefront mathing method. The low-loss bandwidth of the optimized structure is 4-times wider than that of conventional structure.	FM1G.4 • 09:00 An experimental study for characterizing surface roughness by speckle pattern analysis, Abdiel O. Pino ¹ ; ¹ Technological Univ. of Panama, Panama. We presented a method of measure of the rugosity based in the analysis of the texture of the speckle's pattern. We used GLCM to extract the rugosity. Our experimental results correlates appropriately with autocorrelation function.	LM1H.3 • 09:00 Coherent Diffractive Imaging Using Randomly Coded Masks, Matthew Seaberg ^{1,2} , Joshua Turner ¹ , Alexandre d'Aspremont ^{2,3} ; <i>ISLAC National Accelerator Lab, USA</i> ; ² <i>CNRS</i> , <i>France</i> ; ³ <i>DI</i> , <i>ENS</i> , <i>France</i> . We report the first experimental demonstration of encoded coherent diffractive imaging using a series of randomly coded masks. This technique enables high quality coherent imaging without the use of typical object constraints.	LM11.3 • 09:00 Invited Spectroscopic Photoacoustic Imaging for the Detection of Lymph Node Metastases, Geoffrey Luke ^{2,1} , Konstantin Sokolov ³ , Stanislav Emelianov ^{1,1} ; 'Biomedical Engineering, Univ. of Texas at Austin, USA; ² Thayer School of Engineering, Dartmouth College, USA; ³ Imaging Physics, MD Anderson Cancer Center, USA; ⁴ Electrical and Computer Engineering, Georgia Inst. of Technology, USA. We demonstrate the abil- ity for spectroscopic photoacoustic imaging to detect the presence of metastases in murine lymph nodes based on functional and, with the introduction of targeted nanoparticle contrast agents, molecular expressions.

09:00-16:00 CAM Lounge, Market Street Foyer

California	Valley	Crystal	Gold	Empire	
FiO					
11A • Laser-plasma-based condary Sources I—Continued	FM1B • Integrated Plasmonics—Continued	FM1C • Symposium on Photoreceptor Analysis and Single-cone-mediated Vision— Continued	FM1D • Nonlinear Optics in Micro or Nano-Optical Structures I— Continued	FM1E • Emerging Technologie for High Speed Optical Communications I—Continued	
11A.4 • 09:15 trafast Non-Paraxial Autofocusing Pulses High-Gradient Electron Acceleration , ng Jie Wong ^{2,1} , Ido Kaminer ² ; ¹ Sg Inst. of <i>inufacturing Tech, Singapore; ²MIT, USA</i> . present ultrafast non-paraxial autofocusing ams that exhibit abrupt, ultra-intense focusing ooth space and time. We demonstrate their lity to linearly accelerate on-axis electrons h effective gradients exceeding 300 GeV/m.	FM1B.5 • 09:15 C Compensating Plasmonic Losses by Wave- front Manipulation, Itai Epstein ¹ , Yuval Tsur ¹ , Ady Arie ¹ ; ' <i>Tel Aviv Univ., Israel.</i> We demon- strate experimentally the generation of unique surface-plasmon beams, which compensate the inherent losses of plasmons without us- ing gain media, and show that these beams can extend the limited propagation length of surface-plasmons.		FM1D.5 • 09:15 Nonlinear Cavity Response under Coherent Excitation: Numerical and Experimental Investigation, Samuel F. Serna Otálvaro ^{1,2} , Jeremy Oden ² , Xavier Le Roux ¹ , Philippe De- laye ² , Eric Cassan ¹ , Nicolas Dubreuil ² ; ¹ France; ² Laboratoire Charles Fabry, Institut d'Optique, Université Paris-Sud 11, France. We present a study on the transient operation of a microcavity under a coherent excitation. Through appropri- ate shaping of the incident signal, the coupling efficiency and the enhancement of the non- linearities are shown to be increased.	FM1E.5 • 09:15 C All-optical OFDM Transmission Sys RZ-DQPSK Signaling, Seyededriss Mirr rikandi ¹ ; ¹ Florida Inst. of Technology, U: RZ-DQPSK modulation technique is props all-optical orthogonal frequency-division plexing transmission system. The perform of the proposed system is eveluated and pared to that of traditional NRZ-DQPSK sch	
11A.5 • 09:30 13.5 • 09:30 13.6 14.5 • 09:30 14.5	FM1B.6 • 09:30 Spectral Light Separator: The Subwavelength- size Device to Spectrally Decompose Light in an Efficient Way, Yasin Buyukalp ¹ , Peter B. Catrysse ¹ , Wonseok Shin ¹ , Shanhui Fan ¹ ; ¹ E. L. Ginzton Lab and Dept. of Electrical Engineer- ing, Stanford Univ., USA. We exploit the unique properties of deep-subwavelength resonant apertures in a metallic film to design an ex- tremely efficient, subwavelength-size device to decompose light into its spectral components with negligible spectral crosstalk and without spatial coregistration errors.	FM1C.4 • 09:30 Invited Probing Human Spatial and Color Vision on a Cellular Scale, Austin J. Roorda'; 'Univ. of California Berkeley, USA. A combination of high resolution imaging and eye tracking enables vision testing on a cellular scale. The aim of the talk will be to demonstrate how eye movements can facilitate fine spatial and color vision.	FM1D.6 • 09:30 D WIO Four-Wave Mixing in Silicon-Rich Nitride Waveguides, Miranda Mitrovic', Xiaowei Guan', Hua Ji', Leif K. Oxenløwe', Lars H. Frandsen'; 'Dept. of Photonics Engineering, Technical Univ. of Denmark, Denmark. We demonstrate four-wave mixing wavelength conversion in silicon-rich nitride waveguides which are a promising alternative to silicon for nonlinear applications. The obtained conversion efficiency reaches -13.6 dB while showing no significant nonlinear loss.	FM1E.6 • 09:30 Invited Nonlinear Fourier Transform for Optical munications, Sergei K. Turitsyn'; 'Aston UK. The nonlinear Fourier transform, also k as eigenvalue commnications, is a transm and signal processing technique that r positive use of the nonlinear propertit fibre channels. I will discuss recent pro- in this field.	
11A.6 • 09:45 Juence of Orientational Nonlinearity on ird-Harmonic Generation at Organic Sol- hts, Emerson C. Barbano', Maria Miguez', gio C. Zilio', Lino Misoguti'; 'Universidade <i>Sao Paulo, Brazil.</i> We report studies of entational nonlinearities influence on THG interfaces of a cuvette filled with organic vents by means of pulse duration. Electronic d orientational nonlinearities are affected tinctly depending of pulse duration.			FM1D.7 • 09:45 Stable Optical Vortices Solitons Propagation in CS ₂ , Albert Reyna Ocas ¹ , George Boudebs ² , Boris A. Malomed ^{1,3} , Cid B. de Araujo ¹ ; ¹ Universi- dade Federal de Pernambuco, Brazil; ² Universit d'Angers, France; ³ Tel Aviv Univ., Israel. The stable propagation of two-dimensional vortex solitons in CS ₂ is reported. The intensity depen- dence of the nonlinear refractive index and three photon absorption are the key mechanisms to arrest the azimuthal symmetry breaking.		
	10:00–10:30	Coffee Break, Market Street & South	Tower Foyers		

Fairfield	Sacramento	Hillsborough	Piedmont
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FM1F • Novel Concepts in Waveguide Optics—Continued	FM1G • Optical Fabrication and Testing— Continued	LM1H • Carl E. Anderson Award for Outstanding Doctoral Dissertation in Laser Science—Continued	LM11 • Nonlinear and Spectroscopic Imaging I—Continued
FM1F.6 + 09:15 High-Density Low-Crosstalk Waveguide Superlattice, Karon Stein ² , Waren Y. Lai ^{1,3} , John Provine ⁴ , Fabian Pease ⁴ , Dentrios N. Christodoulide ⁵ , Wei Jiang ^{1,4} , 'Dept. of Electrical and Computer Engineering, Rutgers Univ., USA; 'Center for functional Nanomaterials, Brookhaven National Lab, USA, 'Inst. for Advanced Materials, Devices, and Nanotechnology, Rutgers Univ., USA; 'Dept. of Electrical Engineering, Stan- ford Univ., USA; 'School of Optics/CREOL, Univ. of Central Florida, USA; 'National Lab of Solid State Microstructures, maing Univ., China. Waveguides are ubiquitous in silicon photonics. The density of waveguides is crucial to the inte- gration density. We propose and demonstrate a waveguide superlattice that enables high-density waveguide integration at a half-wavelength pitch with low crosstalk. Ruter State Microstructures, mow avait mobile for Univ.	5 Program lable in prmats!	LM1H.4 • 09:30 WiO Direct Mapping of Optical Near Field Forces from Plas- monic Nano-tweezers, Yang Zhao', Amr Saleh', Marie Anne van de Haar ² , Albert Polman ² , Jennifer Dionne'; 'Stanford Univ., USA; '2POM Inst. AMOLF, Netherlands. Near field optical forces from a plasmonic nano-aperture shows great promise to directly trap biological specimens in nano-meter dimensions. Here we directly map optical forces through a nano coaxial tweezer using atomic force microscopy.	LM11.4 • 09:30 Invited Nanoscale Spectroscopic Imaging with Photo-induced force Microscopy, Junghoon Jahng ¹ , Eric O. Potma ¹ ; ¹ Unix of California Irvine, USA. Photo-induced force microscopy produces images with spectroscopic contrast at nanometer scale resolution. In this presentation, the basic principles of the photo-induced force microscope are described and ap- plication examples of this technique are highlighted.
	10:00–10:30 Coffee Break, Ma	arket Street & South Tower Foyers	

California	Valley	Crystal	Gold	Empire		
	FiO					
10:30–12:00 FM2A • Laser-plasma-based Secondary Sources II Presider: Igor Jovanovic; Pennsylvania State Univ., USA	10:30–12:00 FM2B • Biophotonics for Point- of-Care and Global Health Applications Presider: Aydogan Ozcan; Univ. of California Los Angeles, USA	10:30–11:45 FM2C • Novel Methods for Tissue Imaging and Therapy Presider: Steven Adie; Cornell Univ., USA	10:30–12:00 FM2D • Nonlinear Optics in Micro or Nano-Optical Structures II Presider: Mattia Mancinelli, Universita degli Studi di Trento, Italy	10:30–12:00 FM2E • Emerging Technologies for High Speed Optical Communications II Presider: Sergei Turitsyn, Aston Univ., UK		
FM2A.1 • 10:30 Tutorial Laser-Plasma-Based Secondary Sources: Accelerating Particles and Light, Christian Spielmann ^{1,2} ; 'Univ. of Jena, Germany; 'Helm holtz Institut Jena, Germany. Extraordinary progress has been made in the understanding progress have now a detailed understanding how to accelerate particles and realize brilliant pulsed hard x-ray sources.	FM2B.1 • 10:30 Invited O Optically Modulated Electrokinetic Particu- late and Fluid Manipulation, Steve Wereley'; 'Purdue Univ., USA. Illumination patterns are used to drive electrothermal flows for sorting and manipulating particulates for Lab-on-Chip applications. Plasmonics has been used to enhance the optical coupling.	FM2C.1 • 10:30 Invited D Design and Validation of a Spatial Frequency Domain Imaging (SFDI) System for Biomedical Research Applications, David Cuccia'; 'Modu- lated Imaging Inc, USA. We have developed a turn-key LED-based multispectral structured- light imaging platform for biomedical research, with a focus on enabling spatial frequency domain imaging (SFDI). We will cover system validation in-silico, on phantoms, and with pre- clinical models.	FM2D.1 • 10:30 Invited Division Low Power Nonlinear Optics in Nanophotonic Structures, Jelena Vuckovic'; 'Stanford Univ., USA. Very strong light-matter interaction and optical nolinearity at the level of few photons is achieved by employing optical nanocavi- ties (e.g., in GaAs, GaP, SiC) with embedded quantum emitters, such as quantum dots and color centers.	FM2E.1 • 10:30 Invited FM2E.1 • 10:30 Invited FM3E.1 • 10:30 Few-mode Fiber, Alan Pak Tao Lau ¹ , Qi Sui ² , John D. Downie ³ , Wil- liam A Wood ³ , Jason Hurley ³ , Snigdharaj Mishra ³ , Chao Lu ⁴ , Hwa-yaw Tam ¹ , P.K.A. Wai ⁴ ; ¹ Photonics Research Center, Dept. of Electrical Engineering, Hong Kong Polytechnic Unix, Hong Kong; ² Inst. of Photonics Technology, Jinan Unix, China; ³ Corning Incorporated, USA; ⁴ Photonics Research Center, Dept. of Electronic an information Engineering, The Hong Kong Polytechnic Unix, Hong Kong. We review recent developments in quasi-single-mode (QSM) transmissions using few-mode fibers (FMF) with appropriate DSP algorithms as an alternative to overcome fiber nonlinearity in long-haul optical communication systems.		
Christian Spielmann studied and did his PhD in 1992 at the TU Vienna. After post-doc stays at the University of California in San Diego and the TU Vienna he habilitated 1999 in Vienna. In 2001 he went to the University of Würzburg as professor. Since 2008 he is chair at the Quantum Electronics department at the University of Jena, where he works on strong field optics and x-ray science. Besides his research activities he is a member of the Board of Director of the Abbe Center of Photonics and speaker of the graduate school of the Helmholtz Institute Jena.	FM2B.2 • 11:00 Google Glass-based Rapid Analysis of Immuno-chromatographic Diagnostic Tests, Steve Feng ¹ , Romain Caire ¹ , Bingen Cortazar ¹ , Mehmet Turan ¹ , Andrew Wong ¹ , Aydogan . Ozcan ^{1,2} , 'Electrical Engineering, Univ. of California, Los Angeles, USA; 'Bioengineering, Univ. of California, Los Angeles, USA. For rapid, real-time disease diagnostics, we demonstrate the ability of the Google Glass to perform qualitative and quantitative analysis of lateral- flow immuno-chromatographic diagnostic tests.	FM2C.2 • 11:00 Invited D High-speed Fluorescence Histology For Near- patient Surgical Pathology, J. Quincy Brown ¹ ; ' <i>Tulane Univ., USA</i> . We describe high-speed structured illumination microscopy, combined with fast-acting topical fluorescent stains which recapitulate H&E histology, as an accurate and practical alternative to frozen section analysis in surgical pathology for detection of positive tumor margins.	FM2D.2 • 11:00 Towards High-Throughput Opto-Mechanical Flow Cytometry, Kewen Han ¹ , JunHwan Kim ¹ , Gaurav Bah ¹ ; 'Univ. of Illinois at Urbana Champaign, USA. We use opto-mechanical sensing on hollow-core silica whispering gal- lery resonators to perform high throughput mechanical measurements on rapidly flowing single particles and cells.	FM2E.2 • 111:00 50 GBaud 16-OAM Transmission Over 2125 km Based on an Injection-Locked Fabry- Perot Laser Carrier, Eduardo Temprana ¹ , Ping Piu Kuo ¹ , Nikola Alic ² , Stojan Radic ^{1,2} ; ¹ UCSD, USA; ² Qualcomm Inst., USA. We propose a transmitter based on injection locking a low- cost Fabry-Perot laser to a reference Optical Frequency Comb. We demonstrate transmission of 50 GBaud 16-OAM over 2125 km relying on Digital Back Propagation.		
FM2A.2 • 11:15 Linear and Nonlinear Thomson Scattering Observed Perpendicular to a Relativistic Later Dallas Smith' Michael Ware' Justin	FM2B.3 • 11:15 D WiO Microfluidic Device Fabrication Utilizing Vir- tual Masks and Photochemical Etching, Lonna		FM2D.3 • 11:15 D Towards Automated Deterministic Comb Generation in Microresonators: Overcoming	FM2E.3 • 11:15 45Gb/s PAM4 VCSEL 850/940nm Transmis- sion over OM3 and OM4 Multimode Fibers,		

Laser, Dallas Smith¹, Michael Ware¹, Justin Peatross¹; ¹Brigham Young Univ., USA. We analyze single-photon fundamental, second and third harmonic light scattered out the side of an intense laser focus, interacting with individual free electrons. Such measurements provide additional insights into interaction dynamics via non-phase-matched incoherent emission.

Edwards¹, Kaiyuan Wang¹, Chris Edwards¹, Xin

Yu¹, Shailendra Srivastava¹, Gang L. Liu¹, Lynford

L. Goddard1; 1Univ. of Illinois - UC, USA. We

demonstrate using virtual masks to perform

photochemical etching to facilitate microfluidic

device fabrication. Applications of this cost-

efficient alternative to conventional fabrication

methods are expansive in many fields such as

medical diagnostics.

Thermal Shift, Jose A. Jaramillo-Villegas^{1,2},

Yang Liu¹, Pei-Hsun Wang¹, Yi Xuan^{1,3}, Daniel

E. Leaird¹, Minghao Qi^{1,3}, Andrew M. Weiner^{1,3};

¹School of Electrical and Computer Engineering,

Purdue Univ., USA; ²Facultad de Ingenierías,

Universidad Tecnológica de Pereira, Colom-

bia; ³Birck Nanotechnology Center, Purdue

Univ., USA. We present a computer automated

method to generate optical frequency combs in microring resonators and measure its characteristics in fine changes in frequency detuning taking advantage of thermal red shift at thermal

equilibrium points.

Reza Motaghian¹, Ilya Lyubomirsky¹, Henry

Daghighian¹, Chris Kocot¹; ¹Finisar, USA. We

present experimental data demonstrating

45Gb/s VCSEL transmission over 200m of

OM3 and 300m of wideband OM4 fibers

at 850/940nm. The measured PAM4 OMA-

sensitivity was -15.0 dBm at 2e-4 over 100m

OM3 fiber at 850/940nm.

40

Fairfield

FM2F • Advances in Ocular Biometry and

Advances in Anterior Segment OCT: Crystalline and

Intraocular Lens Applications, Susana Marcos¹, Pablo

Perez-Merino¹, Eduardo Martinez-Enriquez¹, Mengchan Sun¹,

Miriam Velasco¹; ¹Consejo Sup Investigaciones Cientificas,

Spain. We quantified anterior-segment geometry in young eyes and eyes implanted with IOLs using quantitative custom-

developed sOCT. Crystalline lens curvature and high-order surface-elevation terms changed with accommodation. OCTbased computer eye-models predicted optical aberrations

Presider: Brian Vohnsen, Univ. College

Studies of the Anterior Eye

FM2F.1 • 10:30 Invited WiO

Sacramento

Presider: Simon Thibault; Universite Laval,

Hillsborough

Piedmont

LS

10:30-12:00 LM2H • Computational Optical Imaging I Presider: Rafael Piestun; Univ. of Colorado at Boulder, USA

LM2H.1 • 10:30 Invited

Extreme Imaging and Beyond, Keisuke Goda1; 1Univ. of Tokyo, Japan. I introduce a unique ultrafast optical imaging method known as sequentially timed all-optical mapping photography (STAMP) which enables motion-picture femtophotography at an unprecedented frame rate of more than a trillion frames per second.

10:30-12:00

LM2I • Accelerating Wavepackets in Optics and Beyond I Presider: Jeffrey Field, Colorado State Univ., USA

LM2I.1 • 10:30 Invited

Physics and Applications of Airy Beams and Optical Accelerating Waves, Demetrios N. Christodoulides1; 1Univ. of Central Florida, USA. We provide an overview of recent developments in the area of Airy beams and optical accelerating waves. Applications of these wavefronts will be discussed along with prospects of using similar concepts in other technical disciplines.

FM2G.2 • 10:45 Withdrawn.

FiO

11:00-12:00

FM2G.1 • 10:30

Withdrawn.

Canada

FM2G • Optical Metrology

FM2E.2 • 11:00 Invited

in pseudophakic eyes.

10:30-12:00

Dublin, Ireland

Brillouin Microscopy for Tissue and Cell Biomechanics, Giuliano Scarcelli 1; 1Univ. of Maryland , USA. We have developed an all-optical approach to measure material mechanical properties using Brillouin light scattering. Brillouin imaging uses the elastic modulus as contrast mechanism. We demonstrate its application in vivo for tissue and cellular biomechanics.

FM2G.3 • 11:00

Simple and Accurate Optical Height Sensor for Wafer Inspection Systems, Kei Shimura¹, Naoya Nakai¹, Koichi Taniguchi¹; ¹Hitachi High-Technologies Corporation, Japan. We have developed a height sensor in which eight slits are projected on a surface obliguely and their image is detected by an area sensor. Accuracy of 0.3 um is achieved on patterned wafer.

LM2H.2 • 11:00

Active Illumination Low-light Computational Correlation Microscopy, Milad Akhlaghi Bouzan¹, Thomas Kohlgraf-Owens¹, Aristide Dogariu¹; ¹CREOL, College of Optics and Photonics, Univ. of Central Florida, USA. We present a low-light, reflection mode correlation imaging technique based on sequential random patterns illumination and integrated backscattered light intensity. Live cell and low contrast target imaging at very low-light levels are demonstrated experimentally.

LM2I.2 • 11:00 Invited

Physics and Applications of Accelerating Beams in Optics, John M. Dudley¹, Francois Courvoisier²; ¹Institut FEMTO-ST, Universite de Franche-Comte, France; ²Institut FEMTO-ST, Université de Franche-Comté, France. We review the state of the art of accelerating beams, discussing their properties from perspectives of geometrical optics, Maxwell's equations and catastrophe theory, and surveying results from femtosecond material processing to random roque wave generation.

FM2G.4 • 11:15

Space based measurements of Atmospheric Carbon Dioxide: A New Tool for Monitoring our Environment, David Crisp¹; ¹Jet Propulsion Lab, USA. Precise, global measurements of atmospheric carbon dioxide and other greenhouse gases by the NASA Orbiting Carbon Observatory-2 (OCO-2) and other satellites provide new tools to monitor and manage the processes that control their atmospheric concentrations.

LM2H.3 • 11:15

Star Test Polarimetry at Low Light Levels, Thomas G. Brown¹, Miguel Alonso¹; ¹The Inst. of Optics, USA, Star Test Polarimetry is a method of deducing the complete Stokes vector by applying statistical inference to a polarizationdependent point spread function. We present an analysis and experimental test of this measurement when applied to very low light levels.

California	Valley	Crystal	Gold	Empire
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FM2A • Laser-plasma-based Secondary Sources II—Continued	FM2B • Biophotonics for Point- of-Care and Global Health Applications—Continued	FM2C • Novel Methods for Tissue Imaging and Therapy—Continued	FM2D • Nonlinear Optics in Micro or Nano-Optical Structures II— Continued	FM2E • Emerging Technologies for High Speed Optical Communications II—Continued
FM2A.3 • 11:30 Staged, Guided Laser-Plasma Accelerators Towards Thomson Photon Sources and High Energy Physics, Cameron G. Geddes ¹ , Sven Steinke ¹ , Jeroen van Tilborg ¹ , Brian Shaw ^{1,2} , Nicholas Matlis ¹ , Anthony J. Gonsalves ¹ , Kei Nakamura ¹ , Julius Huijts ¹ , Daniel Mittelberger ¹ , Joost Daniels ¹ , Csaba Toth ¹ , Jean-Luc Vay ¹ , Alexadre Bonatto ¹ , Sergey Rykovanov ^{1.3} , Carl Schroeder ¹ , Carlo Benedetti ¹ , Eric Esarey ¹ , Wim P. Leemans ^{1,2} ; ¹ BELLA Center, Lawrence Berkeley National Lab, USA; ² Dept. of Physics, U.C. Berkeley, USA; ³ Helmholtz Inst., Germany. Experiments characterize two high-gradient laser-plasma accelerators in series, each pow- ered by a separate laser pulse, with application to deceleration for compact high energy pho- ton sources and to high energy future particle physics colliders.	FM2B.4 • 11:30 Differentiation of Morphotic Elements in the Human Blood Using Optical Coherence Tomography and Microfluidic Chip., Pawel Ossowski ^{1,2} , Anna Raiter ² , Anna Szkulmowska ² , Maciej Wojtkowski ^{1,2} ; 'Inst. of Physics, Faculty of Physics, Astronomy and Informatics, Nicolaus Opernicus Univ. , Poland; ² AM2M LLC-LP, Poland. We propose a novel microfluidic opti- cal flow cytometry technique of differentiating biological objects in microfluidic devices using OCT backscattered light initially disturbed by the object and secondarily scattered by a mate- rial of known optical properties.	FM2C.3 • 11:30 Two-Photon Mueller Matrix-Second-Harmonic Generation Microscopy of Porcine Samples, Chukwuemeka Okoro', Kimani C. Toussaint'; 'Unix. of Illinois Urbana-Champaign, USA. Quantitative assessment of collagen-based porcine samples is performed using two-photon Mueller matrix analysis of second-harmonic generation (SHG) images. A depolarization parameter is evaluated as a function of sample type and thickness.	FM2D.4 • 11:30 D Doservation of PT-symmetric optical solitons in time-domain photonic lattices, Martin Wim- mer ^{2,3} , Alois Regensburger ² , Mohammad-Ali Min ¹ , Christoph Bersch ² , Demetrios N. Christo- doulides ¹ , Ulf Peschel ⁴ ; ¹ Univ. of Central Florida, USA; ² Inst. of Optics, Information and Photonics, Friedrich-Alexander-Universität Erlangen Nümberg, Germany; ³ Erlangen Graduate School in Advanced Optical Technologies, Germany; ⁴ Inst. of Solid State Theory and Optics, Friedrich Schiller Univ. Jena, Germany. We report the first experimental observation of optical solitons in PT-symmetric temporal lattices. By utilizing a judicious balance between gain, loss and non- linear effects, such self-trapped states remain stable over long distances.	FM2E.4 • 11:30 Invited C High Capacity Fiber Optic Submarine Trans- mission Systems, Alexei N. Pilipetskii'; 'TE SubCom, USA. Today's submarine transmission systems carry tens of Tb/s of transmission capac- ity. The talk will examine specifics of undersea transmission, modern enabling technologies and their limitations. The fundamental issues challenging further long-term transmission capacity growth will be reviewed.
FM2A.4 • 11:45 Measured Thomson Scattering from Diffuse Free Electrons in a Strong Laser Field, Justin Peatross ¹ , Michael Ware ¹ ; Brigham Young Unix, USA. We creat an abadity presurgement of	FM2B.5 • 11:45 C CMOS-Based Implantable Glucose Monitoring Device with Glucose-Responsive Fluorescent Hydrogel, Toshikazu Kawamura ¹ , Tomohiro		FM2D.5 • 11:45 Ultra-narrowband tunable microwave filter created by stimulated Brillouin scattering in a Silicon chip, Alvaro Casas-Bedoya ¹ , Blair	

USA. We report an absolute measurement of Hirai¹, Hironari Takehara¹, Hiroaki Takehara¹, radiation emitted from free electrons emitted Toshihiko Noda¹, Kiyotaka Sasagawa¹, Takashi out the side of an intense laser focus. The Tokuda¹, Teru Okitsu², Shoji Takeuchi², Jun measurement confirms the QED prediction that Ohta1; 1Nara Inst. of Science and Technolemitted radiation is independent of electron ogy, Japan; ²The Univ. of Tokyo, Japan. We designed an implantable glucose monitoring device combining a CMOS line sensor with a glucose-responsive fluorescent hydrogel. The structure of the device was optimized and the

performance was improved.

12:00–13:30 Lunch (on your own)

Morrison¹, Mattia Pagani¹, David Marpaung¹,

Benjamin Eggleton¹; ¹Univ. of Sydney, Australia.

We demonstrate the first tunable microwave

photonic filter based on stimulated Brillouin

scattering in a silicon nanowire. We use the low

on-chip SBS gain to create a notch with 48dB of

suppression and 98MHz linewidth.

12:00–13:30 Frontiers in Photonics Detection Panel Discussion, Belvedere

12:00–13:30 Nonlinear Optics Technical Group Workshop, Atherton

12:00–13:30 OSA Fellow Members Lunch (Advance registration required), Ballroom, The Westin San Jose, 302 S. Market St., San Jose, CA

wave-packet size.

Fairfield	Sacramento	Hillsborough	Piedmont
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FM2F • Advances in Ocular Biometry and Studies of the Anterior Eye—Continued	FM2G • Optical Metrology—Continued	LM2H • Computational Optical Imaging I— Continued	LM2I • Accelerating Wavepackets in Optics and Beyond I—Continued
FM2F.3 • 11:30 Invited Advances in Presbyopia Correction and Cataract Surgery, Geun-Young Yoon ¹ ; 'Univ. of Rochester, USA. The talk will fo- cus on recent advances in optimizing outcomes of presbyopia correction and cataract surgery by using new ophthalmic lens designs, in vivo imaging modality and binocular combination of unequal optical blur.	FM2G.5 • 11:30 A Novel Precise Laser Beam Pointing Method with Dielectric Elastomer, Tomohiko Hayakawa ¹ , Lihui Wang ¹ , Masatoshi Ishikawa ¹ ; 'Univ. of Tokyo, Japan. We proposed to manipulate the exit direction of laser beam precisely by controlling a thickness of a dielectric elastomer actuator. There is no mechanical movement in the system, the direc- tion is determined based on position instead of angle, so this application is valid for long distance.	LM2H.4 • 11:30 Invited Wide-field Adaptive Optics Without Guide Stars, Jerome C. Mertz', Jiang Li', Devin R. Beaulieu', Hari Paudel', Roman Barankov', Thomas Bifano'; 'Boston Univ., USA. We describe a wave-sensor implementation of conjugate adaptive optics applicable to widefield (i.e. non-scanning) microscopy, which can provide aberration corrections over large fields of view without the use of guide stars.	LM2I.3 • 11:30 Invited Diffractionless Waves of Constant Intensity, Konstantinos Makris', Ziad Musslimani ² , Demetrios N. Christodoulides ³ , Stefan Rotter'; 'Inst. for Theoretical Physics, Vienna Univ. of Technology, Austria; ² Mathematics, Florida State Univ, USA; ³ College of Optics-CREOL, Univ. of Central Florida, USA. We introduce a new class of diffraction-free waves in inhomogeneous photonic environments. Such waves have constant intensity in all space and exist only in complex potentials with gain and loss.
	FM2G.6 • 11:45 WiO Reconstruction of High-Resolution Spectra from a Inter- ferometric/Dispersive Spectrometer, Phyllis Ko ¹ , Jill Scott ² , Igor Jovanovic ¹ ; ¹ Pennsylvania State Univ., USA; ² Idaho National Lab, USA. A hybrid interferometric/dispersive instru- ment is used to measure laser-induced plasma spectra. An analysis method that rapidly reconstructs the high-resolution source spectra was developed for this instrument.		
	12:00–13:30 Lu	nch (on your own)	

12:00–13:30 Nonlinear Optics Technical Group Workshop, Atherton

12:00–13:30 OSA Fellow Members Lunch (Advance registration required), Ballroom, The Westin San Jose, 302 S. Market St., San Jose, CA

California Valley Crystal Gold Empire FiO 13:30-15:30 13:30-15:30 13:30-15:30 13:30-15:30 13:30-15:15 FM3B • Plasmonics and FM3E • Optical Design **D** FM3A • Laser-plasma-based FM3C • Symposium on Optics for FM3D • Nonlinear Optics in Micro Nanophotonics **D** Secondary Sources III **Global Health and Low Resource** or Nano-Optical Structures III D Presider: Allen Yi; Ohio State Univ., Presider: Cameron Geddes; Presider: Alexandra Boltasseva; Settings **D** Presider: Michael Raymer; Univ. of USA Oregon, USA Lawrence Livermore National Lab, Purdue Univ., USA Presider: J. Quincy Brown; Tulane USA Univ., USA FM3B.1 • 13:30 FM3D.1 • 13:30 Invited WiO FM3A.1 • 13:30 Invited FM3C.1 • 13:30 Invited FM3E.1 • 13:30 Invited The Impact of Temporal and Spatial Scales Projection Microscopy for Medical Diag-Localized Surface Plasmon-Enhanced Light Plasmonic Nanostructures with Well-Con-Consumer Electronic Optics: The Quest for nostics, Manu Prakash¹; ¹Stanford Univ., USA. in Laser Driven Relativistic Fields on Ion Ac-Emitters based on Amorphous Silicon Quantrolled Geometry Lead to Designed Properthe Perfect Lens Design, Simon Thibault^{1,2}; celeration, Matthias Schnürer¹, Florian Abicht¹, Microscopy is gold standard for diagnosing tum Dots through Plasmonic Subwavelength ties, Xiaogin Li¹; ¹Univ. of Texas at Austin, USA. ¹Universite Laval, Canada; ²Immervision, many diseases. Conventional microscopes are Julia Braenzel¹, Lutz Ehrentraut¹, Alexander Metallic Crossed Gratings, Tsung-Han Tsai¹, Near field coupling between metallic nanopar-Canada. Small camera phone are becoming Andreev^{1,2}; ¹B1, Max Born Inst., Germany; ²St. costly, lack portability, and cause eye strain. Wing-Kit Choi¹, Hoang Yan Lin¹; ¹National Taiticles opens a route for controlling light-matter integral in our lives. Sensors have more pixels. Petersburg Univ., Russia. Absolute values of wan Univ., Taiwan. We investigated experimen-We present a new ultra low-cost, portable, interaction at nanometer length scale. Novel they are smaller and smaller and the lens must kinetic ion-energies depend on temporal and projection microscope for diagnostics with field tally the plasmon-enhanced emission enhanceproperties of plasmonic nanostructures can be fit within a cell phone enveloppe! Are we facing spatial scales in highly transient laser driven testing in Kenya. ment of the amorphous silicon quantum dots realized by precisely control the geometry of the miniaturisation limit? Together, we will try to acceleration. Temporal and spatial scales are light-emitting device with the subwavelength nanoparticles. understand the challenges for the lens designer. assessed with specific ion spectral investigation crossed Ag gratings as the top layer in the Ag/ and with proton beam deflectometry. SiO :a-Si QDs/Ag sandwich cavity. FM3B.2 • 13:45 D Narrow bandwidth and Amplified emission of Amorphous Silicon Quantum Dots through the coupling between Fabry - Pérot cav-

FM3B.3 • 14:00 D

nanostructures.

Resolving Ultrafast Molecular Dynamics via Multidimensional High Harmonic Spectroscopy, Barry D. Bruner¹, Hadas Soifer^{2,1}, Matteo Negro³, Michele Devetta³, Davide Faccialà⁴, Valeria Serbinenko⁵, Olga Smirnova⁵, Caterina Vozzi³, Salvatore Stagira⁴, Nirit Dudovich¹; ¹Weizmann Inst. of Science, Israel; ²Stanford Inst. for Materials and Energy Sciences, SLAC National Accelerator Lab, USA; ³Instituto di Fotonica e Nanotecnologie, CNR, Italy; ⁴Dipartimento di Fisica, Politecnico di Milano, Italy: ⁵Max Born Inst. for Nonlinear Optics and Short Pulse Spectroscopy, Germany. Extending the dimensionality of high harmonic generation (HHG) measurements is essential for revealing complex attosecond dynamics. We identify structural and dynamical features in molecular HHG spectra, and resolve the contributions of multiple ionization channels.

FM3A.2 • 14:00 Invited

Combcopolimers of Regioregular Poly 3 Hexylothiophene Applied in Surface Plasmon Resonance Based NO₂ Sensor, Marcin T. Procek¹, Erwin Maciak¹, Agnieszka Stolarczyk², Tadeusz Pustelny¹; 'Dept. of Optoelectronics, Silesian Univ. of Technology, Poland; 'Dept. of Physical Chemistry and Technology of Polymers, Silesian Univ. of Technology, Poland. In this work a novel combcopolimer of regioregular Poly 3-hexylothiophene (rr-P3HT) is applied as a gas (NO₂) sensing material. Gas sensing properties of this material is examined using surface plasmon resonance technique at room temperature.

ity and Localized Surface Plasmons Modes, Tsung-Han Tsai¹, Wing-Kit Choi¹, Hoang Yan Lin¹; ¹National Taiwan Univ., Taiwan. We investigated experimentally the influence of the coupling between the Fabry – Pérot cavity and localized surface plasmons modes on plasmonenhanced photoluminescence of the a-Si QDs LEDs with the Aq/SiO a-Si QDs/Au sandwich

FM3C.2 • 14:00 Invited

Mobile Technologies for Personalized Diagnostics and Global Health, David Erickson'; ¹Cornell Univ., USA. I will review the existing commercial and technical roadblocks to the deployment molecular diagnostics to the consumer market and how they can be fundamentally altered by taking advantage of the now ubiquitous installed base of smartphones.

FM3D.2 • 14:00 D

Non-local Soliton Interactions in Raman-gas Photonic Crystal Fibers, Mohammed F. Saleh^{1,2}, Andrea Armaroli^{2,3}, Andrea Marini^{2,4}, Federicco Belli², Fabio Biancalana^{1,2}, ¹Heriot Watt Univ, UK; ²Max Planck Inst. for the Science of Light, Germany; ³Laboratoire FOTON, France; ⁴ICFO-Institut de Ciencies Fotoniques, Spain. Slow Raman response in gas-filled photonic crystal fibers enables non-local interactions between two successive ultrashort solitons. Different spatiotemporal modulation of the medium refractive index can be obtained by varying time delay between the solitons.

FM3E.2 • 14:00 Invited

Freeform Optical Beam Shaping Following An Optimal Transport Map, Zexin Feng^{2,1}, Brittany Froese³, Lei Huang¹, Mali Gong¹, Guofan Jin¹, Rongguang Liang²; ¹Dept. of Precision Instrument, Tsinghua Univ., China; ²Univ. of Arizona, USA; ³Univ. of Texas at Austin, USA. Following a ray map obtained from the optimal transport viewpoint, we will discuss how to effectively control both the irradiance and wavefront of a light beam using two freeform surfaces constructed by a simultaneous point-by-point procedure.

Fairfield

Sacramento

Hillsborough

Piedmont

13:30-15:30

LS

13:30-15:45 LM3H • Semiconductor NanoOptics I Presider: Tony Heinz; Stanford Univ., USA

Can Opto-Electronics Provide the Motive Power for

Future Vehicles?, Eli Yablonovitch¹: ¹Electrical Engineering

and Computer Sciences Dept., Univ. of California Berkeley,

USA. A rear mirror to reflect band-edge luminescence helped

break the world record for solar cell efficiency, 28.8%. It

serendipitously reflects all infrared wavelengths, which can

revolutionize thermo-photovoltaics. This enables conversion

Eli Yablonovitch is Director of the NSF Center for Energy Efficient Electronics Science (E³S), a multi-University Center based at Berkeley. After a career in industry and Universities, he is now Professor of Electrical Engineering & Computer Sciences at UC Berkeley, where he holds the James & Katherine Lau Chair in Engineering. Based on his mantra "that a great solar cell also needs to be a great LED", his startup company

Alta Devices has held the world record for solar cell efficiency

since 2011, now 28.8%. Yablonovitch is regarded as a Father

of the Photonic BandGap concept, and he coined the term

"Photonic Crystal".

from heat to electricity with >50% efficiency.

LM3H.1 • 13:30 Tutorial

LM3I • Accelerating Wavepackets in Optics and Beyond II Presider: Francois Courvoisier; Universite de

LM3I.1 • 13:30 Invited

Accelerating Wavepackets, Mordechai Segev¹, Ido Kaminer², Elad Greenfield¹, Yaakov Lumer¹, Rivka Bekenstein¹, Jonathan Nemirovsky¹, Uri Bar-Ziv¹; ¹Technion Israel Inst. of Technology, Israel; ²Physics, MIT, USA. We review the recent progress on accelerating wavepackets, highlighting ideas common to many wave systems ranging from self-bending beams of Maxwell's equations and self-accelerating Dirac fermions to deep underwater ultrasonic beams propagating on curved trajectories.

LM3I.2 • 14:00 Invited

Bessel-like self-accelerating beams along predesigned trajectories, Juanying Zhao¹, Ioannis Chremmos², Nikolaos Efremidis³, Zhigang Chen¹; ¹San Francisco State Univ., USA; ²Max Planck Inst. for the Science of Light, Germany; ³Univ. of Crete, Greece. We design and demonstrate self-accelerating Bessel-like beams that can travel along predesigned arbitrary trajectories, including self-breathing, self-spiraling, and selfpropelling Bessel-like beams, along with examples of particle manipulation with such fine-shaped beams.

FiO

13:30-15:30 FM3F • Retinal Imaging, Vasculature, and Photoreceptor Modelling in Healthy and **Diseased Eyes**

Presider: Donald Miller; Indiana Univ., USA

FM3F.1 • 13:30 Invited

Imaging of Human Retinal Microvasculature Using Adaptive Optics Scanning Light Ophthalmoscope, Toco Yuen Ping Chui^{1,2}, Nikhil Menon^{1,2}, Nadim Choudhury^{1,2}, Alexander Pinhas^{1,2}, Yusufu N, Sulai³, Alfredo Dubra^{3,4}, Richard B, Rosen^{1,2}: ¹Ophthalmology, New York Eve and Ear Infirmary of Mount Sinai, USA; ²Ophthalmology, School of Medicine at Mount Sinai, USA; ³Ophthalmology, Medical College of Wisconsin, USA: ⁴Biophysics, Medical College of Wisconsin, USA. In vivo microvascular imaging on healthy and diseased retinas using an adaptive optics scanning light ophthalmoscope (AOSLO) employed with fluorescein angiography and non-confocal imaging techniques will be discussed.

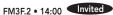
13:30-15:30 FM3G • Novel Materials and Design for **Optical Fibers** Presider: Liang Dong, Clemson Univ., USA

FM3G.1 • 13:30 Invited

Large-Mode-Area All-Solid Photonic Bandgap Fibers for High Power Fiber Lasers, Liang Dong¹, Fanting Kong¹, Guancheng Gu¹, Thomas Hawkins¹, Maxwell Jones¹, Joshua Parsons¹, Monica Kalichevsky-Dong¹, Kunimasa Saitoh², Benjamin Pulford³, Iyad Dajani³; ¹Clemson Univ., USA; ²Hokkaido Univ., Japan; ³AFRL, USA. All-solid photonic bandgap fibers have unsurpassed higher-order-mode suppression in large-mode-area designs, making them well suited for further power scaling of fiber lasers. We will review of some of the recent progress in this invited talk.

Franche-Comte, France





Title to be Determined, Scott Fraser¹; ¹Univ, of Southern California, USA. Abstract not available.

FM3G.2 • 14:00

Investigation of beam self-cleanup process at the multimode fiber edge created by photopolymerization, Haoyu Li^{1,3}, Yue Qi¹, Changliang Guo¹, John T. Sheridan¹, Pengbai Xu², Yongkang Dong², Shu Jia³; ¹School of Electrical, Electronic and Communications Engineering, UCD Communications and Optoelectronic Research Centre, SFI-Strategic Research Cluster in Solar Energy Conversion, College of Engineering and Architecture, Univ. College Dublin, Ireland; ²National Key Lab of Science and Technology on Tunable Laser, Harbin Inst. of Technology, China; ³Dept. of Biomedical Engineering, Stony Brook Univ., USA. A method for beam self-cleanup is introduced by use of self-written waveguides in a photopolymer, acrylamide/polyvinyl alcohol. This work opens the door to study self-developing light cleanup and its further applications.

45

California	Valley	Crystal	Gold	Empire
		FiO		
FM3A • Laser-plasma-based Secondary Sources III—Continued	FM3B • Plasmonics and Nanophotonics—Continued	FM3C • Symposium on Optics for Global Health and Low Resource Settings—Continued	FM3D • Nonlinear Optics in Micro or Nano-Optical Structures III— Continued	FM3E • Optical Design— Continued
	FM3B.4 • 14:15 Invited Photonic Jet and its Applications in Nano- Photonics, Hooman Mohseni'; 'Northwestern Univ., USA. We present our latest results using photonic jets to produce arbitrary local pat- terns with 70 nm resolution on a large area in a single exposure. Our experimental results show promise for selective emitters and flat optics.		FM3D.3 • 14:15 Higher-Order Spontaneous Parametric Down- Conversion With Back-Propagating Idler Us- ing Submicron Poled KTP, Mark Bashkansky ¹ , J. Reintjes ² ; ¹ US Naval Research Lab, USA; ² Sotera Defense Solutions, USA. We demonstrate Spontaneous Parametric Down-Conversion in one-dimensional PPKTP waveguide with coun- ter-propagating signal and idler beams. This is accomplished by using sub-micron poling and higher-order quasi-phase-matching interactions.	
FM3A.3 • 14:30 Multilayer Mirrors for VUV-XUV Attosec- ond Pump-Probe Experiments, Alexander Guggenmos ^{1,2} , Jürgen Schmidt ¹ , Stephan Heinrich ^{1,2} , Bert Nickel ³ , Ferenc Krausz ^{1,2} , Ulf Kleineberg ^{1,2} ; ¹ Ludwig-Maximilians-Universität München, Germany; ² Max-Planck-Institut für Quantenoptik, Germany; ³ Center for NanoSci- ence. Ludwia-Maximilians-Universität München.		FM3C.3 • 14:30 Invited Democratization of Next-Generation Imag- ing, Sensing and Diagnostics Tools Through Computational Photonics, Aydogan Ozcan ¹ ; ¹ Univ. of California Los Angeles, USA. I will review some of the emerging applications and future opportunities created by the use of mobile-phones and other consumer electronics	FM3D.4 • 14:30 Background-Free Characterization of Trav- eling-Wave Optomechanical Devices with Ultrafast Time Domain Spectroscopy, Aleem M. Siddiqui ¹ , Charles Reinke ¹ , Heedeuk Shin ² , Robert Jarecki ¹ , Andrew Starbuck ¹ , Peter T. Rakich ² ; ¹ Sandia National Labs, USA; ² Yale Univ., USA. We employ time-domain measurement of	FM3E.3 • 14:30 System Design for a SPIDER Imager, Sam Thurman ¹ , Richard L. Kendrick ² , Alan Dun Danielle Wuchenich ² , Chad Ogden ² ; ¹ Lock Martin Coherent Technologies, USA; ² L heed Martin Advanced Technology Ce USA. We describe system design princ for a Segmented Planar Imaging Detector Electro-optical Reconnaissance (SPIDER) im

devices for the development of next-generation

imaging, sensing and diagnostics tools through

Quantenoptik, Germany; 3Center for NanoScience, Ludwig-Maximilians-Universität München, Germany. Here, we report on the generation of two independent VUV/XUV attosecond pulses by means of a multilayer split mirror system where each half filters the appropriated pulse from a single High Harmonic gas source.

FM3A.4 • 14:45

Monday, 19 October

Conical Cherenkov Terahertz Emission in Two-Color Laser-Produced Plasma, Yong Sing You^{1,2}, Luke Johnson^{1,3}, Thomas Antonsen¹, Ki-Yong Kim¹; ¹Univ. of Maryland at College Park, USA: ²Stanford Univ., USA: ³Naval Research Lab. USA. We observe conical THz radiation from two-color laser-produced plasma at a broad range of densities. This conical emission results from Cherenkov-like phase-matching between fast moving ionization fronts and slow moving THz radiation.

FM3B.5 • 14:45 D Revealing dispersive phase change in plasmonic nano-objects, Xie Zeng¹, Haifeng Hu², Yongkang Gao³, Dengxin Ji¹, Nan Zhang¹, Haomin Song¹, Kai Liu¹, Qiaoqiang Gan¹; ¹State Univ. of New York at Buffalo, USA; 2Northeastern Univ., China; ³Bell Labs, Alcatel-Lucent, USA. The phase change dispersion during the surface plasmon wave coupling process was extracted experimentally using a slit-groove interferometer and validated through simulation, enriching the fundamental understanding of subwavelength optics on a chip.

computational photonics.

FM3D.5 • 14:45

interwaveguide processes.

Materials Analysis of Microspheres for Frequency Comb Generation, Nicolas N. Riesen¹, Shahraam Afshar V.², Alexandre Francois¹, Tanya M. Monro²; ¹Inst. for Photonics and Advanced Sensing, Univ. of Adelaide, Australia; ²Univ. of South Australia, Australia. This paper evaluates the opportunities for using materials other than silica for frequency comb generation in whispering gallery mode microsphere resonators. It explores dispersion compensation at interesting wavelengths such as within the mid-IR.

a guided-wave nano-optomechanical systems

to reveal the transient phonon response which

would otherwise be obscured by additional

FM3E.4 • 14:45

integrated circuits.

Cloaking in Architecture, Tim Sharpe², Johannes K. Courtial¹; ¹Univ. of Glasgow, UK; ²The Mackintosh Environmental Architecture Research Unit (MEARU), Glasgow School of Art, UK. Ray-optical invisibility cloaking can, in principle, be achieved with micro-structured sheets that perform integral imaging. We discuss potential architectural applications, which range from purely aesthetic to energy-saving.

SPIDER is a concept for making ultra-thin com-

putational imaging systems based on photonic

Hillsborough

LM3H • Semiconductor NanoOptics I-

Piedmont

FiO

FM3F • Retinal Imaging, Vasculature, and Photoreceptor Modelling in Healthy and Diseased Eyes—Continued FM3G • Novel Materials and Design for Optical Fibers—Continued

FM3G.3 • 14:15

Fabrication and Side-Coupling Characterization of Hexagonal Lattice Single-Ring Hollow-Core PCFs, Nitin Edavalath¹, Michael H. Frosz¹, Jean-Michel Ménard¹, Philip S. Russell¹; ¹Max-Planck Inst. for the Science of Light, Germany. A simple method for fabricating single-ring PCFs with precise azimuthal positioning of the cladding capillaries is presented. The fundamental and higher-order modes in two different structures are characterized using prism side-coupling.

FM3F.3 • 14:30 Invited WiO

OCT Angiography Methods in Imaging of the Human Choroid, Iwona M. Gorczynska¹, Justin V. Migacz¹, Robert J. Zawadzki¹, John S. Werner¹; ¹Dept. of Ophthalmology & Vision Science, Univ. of California Davis, Davis, CA, USA. OCT angiography methods: speckle variance, amplitude decorrelation and phase variance will be compared in imaging of the human choroid. Application of split spectrum and volume averaging techniques will be demonstrated with swept source OCT data.

FM3G.4 • 14:30

High Optical Transmission of Polymer Waveguides Fabricated Between Two Optical Fibers, Pshko Mohammed^{1,2}, William J. Wadsworth²; ¹Univ. of Bath, UK; ²Physics Dept, Univ. of Sulaimani, Iraq. Polymer waveguide bridges 40µm to 600µm long have been fabricated between two optical fibers with transmission loss 0.5dB to 1.26 dB over a broad wavelength range. The waveguides were written without using a laser.

FM3G.5 • 14:45

O-switched pulse generation in Yb- and Er-doped fiber laser with WS₂ saturable absorber, Guoqing Hu¹, Meng Zhang¹, Lingling Chen³, Xuekun Zhu¹, Guohua Hu⁴, Richard C. T. Howe⁴, Xin Zhao¹, Zheng Zheng^{1,2}, Tawfique Hasan⁴; ¹School of Electronic and Information Engineering, Beihang Univ., China; ²Collaborative Innovation Center of Geospatial Technology, China; ³Dept. of Optoelectronics Engineering, Shenzhen Univ., China; ⁴Cambridge Graphene Centre, Univ. of Cambridge, UK. We demonstrate Q-switched pulses with 13.6 and 179.6 nJ pulse energy in Yb- and Er-doped fiber lasers using a few-layer WS₂-PVA saturable absorber. We attribute the saturable absorption to edge-induced subbandqap states in WS..

LM3H.3 • 14:45 Invited

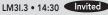
Structural, Electronic, and Optical Properties of Organic Electronic Materials from Density Functional Theory, Leeor Kronik¹; ¹Weizmann Inst. of Science, Israel. 1 will present novel approaches within density functional theory that allow for quantitative predictions of structural, electronic, and optical properties, based on the concept of an optimally-tuned range-separated hybrid functional.

LM3I • Accelerating Wavepackets in Optics and Beyond II—Continued

LM3H.2 • 14:15 Invited

Continued

Strong Terahertz-Field Effect on Electron-Hole System in Quantum Wells, Koichiro Tanaka^{1,2}; ¹Dept. of Physics, Kyoto Univ., Japan; ²Inst. for Integrated Cell-Material Sciences (WPI-iCeMS), Kyoto Univ., Japan. We present strong terahertz light can modulate electron-hole pair creations in 2D-semiconductors. By means of THz pump and optical probe spectroscopy, we observed a strong spectral modulation of the 1s heavy-hole exciton peak of GaAs quantum wells due to Rabi splitting below 10 kV/cm. We also confirmed Franz-Keldysh type spectral modulation and its novel timedependence in the higher field as high as 50 kV/cm.



LS

Guiding Discharges along Curved Paths, Matteo Clerici^{3,1} Yi Hu^{1,4}, Philippe Lassonde¹, Carles Milián⁵, Arnaud Couairon⁵, Demetrios N. Christodoulides⁶, Zhigang Chen⁷, Luca Razzari¹, François Vidal¹, François Légaré¹, Daniele Faccio³, Roberto Morandotti^{1,2}; ¹INRS-Energie Mat & Tele Site Varennes, Canada: ²Inst. of Fundamental and Frontier Sciences. Univ. of Electronic Science and Technology of China, China; ³School of Engineering and Physical Sciences, Heriot-Watt Univ., UK; ⁴The MOE Key Lab of Weak Light Nonlinear Photonics, School of Physics and TEDA Applied Physics School, Nankai Univ., China; ⁵Centre de Physique Theorique, CNRS, Ecole Polytechnique, France; College of Optics - CREOL, Univ. of Central Florida, USA; 7Dept. of Physics and Astronomy, San Francisco State Univ., USA. We show that the intriguing properties of certain shaped laser beams, such as the ability to propagate on curved trajectories and to regenerate after obstacles, allow a novel control of an electric discharge in air.

California	Valley	Crystal	Gold	Empire	
FiO					
FM3A • Laser-plasma-based Secondary Sources III—Continued	FM3B • Plasmonics and Nanophotonics—Continued	FM3C • Symposium on Optics for Global Health and Low Resource Settings—Continued	FM3D • Nonlinear Optics in Micro or Nano-Optical Structures III— Continued	FM3E • Optical Design— Continued	
FM3A.5 • 15:00 Power Enhancement Cavity for Burst-Mode Laser Pulses, Yun Liu ¹ , Abdurahim Rakhman ^{1,2} , Michael Baude ^{1,2} , Mark Notcutt ³ , ¹ Oak Ridge National Lab, USA; ² Dept. of Physics and Astronomy, Univ. of Tennessee, USA; ³ Stable Laser Systems, USA. We demonstrate a novel optical cavity scheme and locking method that can realize the power enhancement of picosec- ond UV laser pulses operating at a burst mode with arbitrary burst (macropulse) lengths and repetition rates.	FM3B.6 • 15:00 Broadband Circular Dichroism Through An Achiral Metasurface, Haoran Ren ¹ , Xiangping Li ¹ , Qiming Zhang ¹ , Min Gu ¹ ; ¹ Faculty of Sci- ence, Engineering and Technology, Swinburne Univ Tech, Australia. We demonstrate a direct distinguishing feature of circularly polarized light through a single nano-aperture. Giant circular dichroism is achieved over a broad spectrum through an achiral metasurface with an orbital angular momentum beam.	FM3C.4 • 15:00 Invited C Low-Cost Optical Diagnostic Systems for Point of Care Applications, Tomasz Tkaczyk'; ¹ <i>Rice Univ.</i> , USA. I will discuss the designs, manufacturing methods, imaging performance and costs of integrated optical systems used for POC. A number of technological choices will be presented (opto-mechanics, optical elements, electronics and control). Examples of POC ap- plications will be also provided.	FM3D.6 • 15:00 Super Oscillating Nonlinear Crystal, Roei Remez ¹ , Ady Arie ¹ ; ' <i>Tel Aviv Univ., Israel.</i> The spectral acceptance bandwidth of a standard nonlinear crystal is inversely proportional to the crystal length. We experimentally show that much narrower width is reached by modulating the nonlinear coefficient with a super-oscillation function.	FM3E.5 • 15:00 Progress towards building pixelated transformation-optics devices, Euan Cowie ¹ , Cyril Bourgenot ² , David Robertson ² , Johannes K Courtial ¹ ; 'Univ. of Glasgow, UK; ² Dept. of Physics, Durham Univ., UK. We report progress in the design and manufacture of micro-structured surfaces that change the direction of transmitted light rays. Such pixellated generalised refrac- tion is general enough to design pixellated transformation-optics devices.	
FM3A.6 • 15:15 Characterization of Auger Recombination and Its Contribution to the Efficiency Droop in III-Nitride Quantum Wells, Mohammad Tollabi Mazraehno ^{1,2} , Bastian Galler ² , Michael Binder ² ; ¹ Inst. of Applied Physics, Germany; ² OSRAM Opto Semiconductors GmbH, Germany. Tai- lored (AlGaln)N multi-quantum well structures are characterized using low temperature pho- toluminescence spectroscopy. The results show that Auger recombination plays a key role in the efficiency droop in (AlGaln)N based LEDs at high carrier densities.	FM3B.7 • 15:15 E WiO In-Situ and Real-Time Monitoring of Chemi- cal Reactions Enabled by Ultra-Sensitive and Reproducible SERS, Jing Long ¹ , Tian Yang ¹ ; 'Shanghai Jiao Tong Univ., China. The dimer- ization process of 4NBT to DMAB was driven by localized surface plasmons and monitored in-situ by ultra-sensitive and reproducible SERS in gold nanosphere-plane junctions. Raman spectral lines of possible intermediate products were observed repeatedly.		FM3D.7 • 15:15 C Nonlinear refractive index larger than linear index: towards all-optical switching with terahertz bandwidth using epsilon-near-zero thin film, Mohammad Z. Alam ¹ , Israel De Leon ¹ , Robert W. Boyd ^{1,2} ; ¹ Univ. of Ottawa, Canada; ² Inst. of Optics, Univ. of Rochester, USA. We show that in epsilon-near-zero regime the nonlinear real index of an indium tin oxide thin film can be much larger than the linear part. This allows for greater than 10dB amplitude modulation with 500 fs.		
	15:30–16:00	Coffee Break, Market Street & South	Tower Foyers		
	16:00–18:00 International Ye	ear of Light – Science to Solutions Spe	cial Session, Regency Ballroom		
		Optical Coherence Tomography Tech			

18:00–19:00 Meet OSA's Journal Editors, Club Regent, Lobby Level

18:30–20:30 International Year of Light/OSA Presidents Reception, City Hall Rotunda, 200 E. Santa Clara St., San Jose, CA

Fairfield	Sacramento	Hillsborough	Piedmont
FiO		L	S
FM3F • Retinal Imaging, Vasculature, and Photoreceptor Modelling in Healthy and Diseased Eyes—Continued	FM3G • Novel Materials and Design for Optical Fibers—Continued	LM3H • Semiconductor NanoOptics I— Continued	LM3I • Accelerating Wavepackets in Optics and Beyond II—Continued
FM3F.4 • 15:00 WiO Modelling Total Cones in the Macula from AOSLO Data, Ann E. Elsner ¹ , Stephen A. Burns ¹ ; 'Indiana Univ., USA. We modelled the total cones within a central circle of 7 deg of retina, using from Adaptive Optics Scanning Laser Oph- thalmoscope, finding an average of 221,000 cones. The coeficient variation was only .0767.	FM3G.6 • 15:00 Sub-wavelength confinement in dual capillary assisted chalcogenide core optical fiber for Mid-IR Applications, Viswatosh Mishra ¹ , Satya P. Singh ¹ , Raktim Haldar ¹ , Shailendra K. Varshney ¹ ; 'Indian Inst. of Technology Kharagpur, India. The sub-wavelength confinement of electromagnetic field is exploited to attain unconventional, almost-flattened and tunable spectral behaviour of effective mode-area and mul- tiple zero dispersion points in nano-sized dual air-capillary assisted chalcogenide optical fiber for mid-IR applications.		LM31.4 • 15:00 Invited Linear and nonlinear exotic light wave packets physics and applications, Stelios Tzortzakis ^{1,2} ; 'IESL-FORTH & Univ. of Crete, Greece; ² Texas A&M Univ. at Qatar, Qatar. Exotic linear and nonlinear wave packets propagating in isotropic and periodically modulated media present exciting propaga- tion properties, like the support of robust intense light bullets and the remote deposition of very high laser intensities.
FM3F.5 • 15:15 Modeling High-Resolution SLO and OCT Retinal Imaging using Backscattering of Light from Elementary Sources, Brian Vohnsen ¹ , Stacey S. Choi ² , Nathan Doble ² , Elaine Wells- Gray ² , Heping Xu ³ , Alan Stitä ³ ; ¹ Univ. College Dublin , Ireland; ² Ohio State Univ. , USA; ³ Queen's Univ., UK. Photoreceptor imaging is feasible due to refractive-index discontinuities across the retinal layers. These can alter the light distribution at the visual pigments and impact vision. Here, we analyze a light-scattering model for improved retinal analysis.	FM3G.7 • 15:15 Cascaded Photonic Crystal Fibers for Three-stage Third- order Soliton Compression, Zihao Cheng ¹ , Qian Li ¹ ; ¹ Peking Univ. Shenzhen Graduate School, China. A detailed fiber design was presented for the first time for three-stage third- order soliton compression at the wavelength of 1.06 μm. A compression factor of 173 was realized, and the remained pedestal is only 58.25%.	LM3H.4 • 15:15 Invited Visualization of Charge Carrier Dynamics in Semiconductor Nanowires Using Pump-Probe Microscopy, John Papaniko- las ¹ ; 'Univ of North Carolina at Chapel Hill, USA. Spatially resolved pump-probe microscopy is used to image carrier transport in individual nanowires. Diffusion of charge carriers in Si nanowires and charge separation in a nanowire encoded with an axial p-i-n junction will be discussed.	

15:30–16:00 Coffee Break, Market Street & South Tower Foyers

16:00–18:00 International Year of Light – Science to Solutions Special Session, Regency Ballroom

18:00–19:00 OSA Microscopy and Optical Coherence Tomography Technical Group Poster Session, Atherton

18:00–19:00 Meet OSA's Journal Editors, Club Regent, Lobby Level

18:30–20:30 International Year of Light/OSA Presidents Reception, City Hall Rotunda, 200 E. Santa Clara St., San Jose, CA

California	Valley	Crystal	Gold	Empire
		FiO		
	07:0	0–18:00 Registration, Market Street H	oyer	
	08:00-09:30 JTu1A •	Joint FiO/LS Plenary and Awards Sess	ion I, Regency Ballroom	
	09:00	D-16:00 CAM Lounge, Market Street	Foyer	
	09:30-	-16:00 Exhibit Hall Open, Imperial Ba Ribbon Cutting Ceremony at 09:30	llroom	
	09:30-10:30 Uno	pposed Exhibit Only Time, Exhibit Ha Coffee Break (09:30-10:00)	ll, Imperial Ballroom	
10:30–12:00 FTu2A • Integrated Quantum Optics I Presider: Linda Sansoni; Universität Paderborn, Germany	10:30–12:00 FTu2B • Photonic Crystals Presider: Raphaël Van Laer; Ghent Univ imec, Belgium	10:30–12:00 FTu2C • Wearable Imaging Optics O Presider: Rongguang Liang; Univ. of Arizona, USA	10:30–12:00 FTu2D • Microscopy I Presider: Elliot Botvinick; UC Irvine Beckman Laser Inst., USA	10:30–12:00 FTu2E • Engineered Frequency Combs in Passive and Active Systems I Presider: Ian Coddington; NIST, USA
FTu2A.1 • 10:30 Invited Quantum Computing , Jeremy L. O'Brien'; <i>'Univ. of Bristol, UK.</i> Of the various approaches to quantum computing, photons are appeal- ing for their low-noise properties and ease of manipulation at the single qubit level; while the challenge of entangling interactions between photons can be met via measurement induced non-linearities. However, the real excitement with this architecture is the promise of ultimate manufacturability: All of the components—inc. sources, detectors, filters, switches, delay lines—have been implemented on chip, and increasingly sophisticated integration of these components is being achieved. We will discuss the opportunities and challenges of a fully inte- grated photonic quantum computer.	FTu2B.1 • 10:30 C Froidic Silicon Ridge Waveguides Exhibiting Degenerate Band Edge Resonances, Michael G. Wood', Justin R. Burr ¹ , Ronald M. Reano ¹ ; 'Ohio State Univ., USA. We experimentally demonstrate degenerate band edge resonances is ridge waveguides that are compatible with active electro-optical devices. Quality factors of the first band edge resonances scale to the fifts-power of the number of periods. FTUEB.2 • 10:45 C Tight Control of Light Beams in Photonic (rystals with Spatially-Variant Unit Cells, Rashi Sharma ² , Stephen M. Kuebler ² , Jennefir of Texas at El Paso, USA; ² Univ. of Central Flori- da, USA. Spatially-variant photonic crystals can be used to direct light through tight turns, with turning radii as small as R _{bend} ~ 20 µm, whereas waveguides having similar R _{bend}	FTu2C.1 • 10:30 Invited O Optical Technologies for See through Wear- able Displays: A Review, Bernard Kress ¹ ; 'Google, USA. The recent hype in wearable VR, AR and Smart Glasses pushed industry to de- velop novel optical technologies implemening a wide variety of optical combining and sensing functionality. We are aiming at reviewing and classifying such technologies.	FTu2D.1 • 10:30 Invited No Vivo Imaging of Cell Dynamics in Animal Models of Neurological Disease using Non- linear Microscopy, Chris B. Schaffer'; 'Cornell Univ., USA. We use nonlinear microscopy to observe and manipulate cell behavior in the central nervous system, focusing on studies of how microvascular hemorrhages impact brain cell function and why brain blood flow is reduced in Alzheimer's disease.	FTu2E.1 • 10:30 Invited O Utra-low Phase Noise Frequency Combs, Chien-Chung Lee ¹ , Dong Hou ¹ , Zhengyin Yang ¹ , Thomas R. Schibli ¹ , ¹ Univ. of Colorado at Boulder, USA. Emerging applications put increasing demands on the short-term stability of frequency combs. We review how ultra-low noise oscillator design combined with improved loop gain and bandwidth continue to enable these most challenging applications to date.

Glen Ellen	Sacramento	Hillsborough	Piedmont			
F	FiO	1	LS			
	07:00–18:00 Registration, Market Street Foyer					
	08:00–09:30 JTu1A • Joint FiO/LS Plenary and Awards Session I, Regency Ballroom					
	09:00–16:00 CAM Lour	I nge, Market Street Foyer				
	09:30–16:00 Exhibit Hall Open, Imperial Ballroom Ribbon Cutting Ceremony at 09:30					
	09:30–10:30 Unopposed Exhibit Onl Coffee Break (nly Time, Exhibit Hall, Imperial Ballroom : (09:30-10:00)				

10:30-11:45 FTu2F • General Quantum Electronics I Presider: Rafael Piestun; Univ. of Colorado at Boulder, USA

FTu2F.1 • 10:30

Transfer of the orbital angular momentum of light to its polarization via classical nonseparability, Seyed Mohammad Hashemi Rafsanjani¹, Mohammad Mirhosseini¹, Omar S. Magana-Loaiza¹, Robert W. Boyd^{1,2}; ¹Univ. of Rochester, USA; ²Physics, Univ. of Ottawa, Canada. We demonstrate a protocol that utilizes nonseparability between different degrees of freedom of a beam of light to transfer an arbitrary, and a priori unknown, state of two different OAM modes onto the polarization, in a fashion that is analogous to teleportation using quantum entanglement.

FTu2F.2 • 10:45 WiO

Master Equation Approach for Quantum Noise in Atomic Systems for Gravitational-Wave Detection, Minchuan Zhou¹, Selim M. Shahriar¹; ¹Northwestern Univ., USA. We use the master equation approach to compute the quantum noise in three different types of atomic systems and then compare the results to the Caves model for phase-insensitive amplifier/ absorber, with application to Gravitational-Wave detection.

10:30-12:00 LTu2G • Precision Laser Spectroscopy I Presider: Esther Baumann, NIST, USA

LTu2G.1 • 10:30 Invited

Precision Laser Spectroscopy of Leptonic Atoms, Paolo Crivelli¹; ¹ETH Zurich, Switzerland. We report the status of our experiments aiming to improve the uncertainty of the current measurements of the 1S-2S transition frequency of Positronium and Muonium.

10:30-12:00 LTu2H • Novel Fiber Lasers I Presider: Nasser Peyghambarian; Univ. of Arizona, USA

LTu2H.1 • 10:30 Invited

Bismuth-Doped Fiber Lasers Covering the Spectral Region 1150 - 1775 nm, Evgeny M. Dianov¹, Sergei V. Firstov¹, Mikhail Melkumov¹; ¹Fiber Optics Research Center RAS, Russia. Bismuth-doped fibers are promising active media for the creation of lasers in the near IR region. This paper reviews recent results on the development of new efficient lasers - bismuth-doped fiber lasers operating at wavelengths 1150 – 1775 nm.

California	Valley	Crystal	Gold	Empire
		FiO		
FTu2A • Integrated Quantum Optics I—Continued	FTu2B • Photonic Crystals— Continued	FTu2C • Wearable Imaging Optics—Continued	FTu2D • Microscopy I—Continued	FTu2E • Engineered Frequency Combs in Passive and Active Systems I—Continued
FTu2A.2 • 11:00 Invited Quantum Teleportation with Light-emitting- diodes, Richard M. Stevenson ¹ , Christiana Varnava ^{1,2} , Jonas Nilsson ¹ , Joanna Skiba-Szy- manska ¹ , Branislav Dzurnak ¹ , Marco Lucamarini ¹ , Richard V Penty ² , Ian Farrer ³ , David A Ritchie ³ , Andrew J Shields ¹ ; ¹ Toshiba Research Europe Limited, UK; ² Cawnbridge Univ. Engineering Dept., UK; ² Cavendish Lab, Univ. of Cambridge, UK. Quantum teleportation can provide guaran- teed information security to multi-partite quan- tum communication networks. We report pho- tonic quantum teleportation using a practical semiconductor source of entangled light, based on a quantum dots within a light-emitting-diode.	FTu2B.3 • 11:00 Fat, low-energy switching in GaAs photonic crystal cavities, Ranojoy Bose ¹ , Jason S. Pelc ¹ , Charles M. Santori ¹ , Raymond G. Beausoleil ¹ ; ' <i>HP Labs, USA</i> . We study free carrier dynam- ics in gallium arsenide (GaAs) photonic crystal cavities with resonances near the material band edge. We show that low estimated switching energy of 3 femtojoules can be achieved for 45% transmission contrast.	FTu2C.2 • 11:00 Invited C Monolithic Light Guide Optics for See- through Smart Glasses & Smart Headphones, Khaled Sarayeddine ¹ ; 'Optinvent Inc., France. Optinvent has developed a unique see-through display technology based on thin monolithic plastic light guide enabling AR and Thin form factor Smart glasses. New Smart headphones integrating this technology will be presented and discussed.	FTu2D.2 • 11:00 WiO Understanding the Dynamics of the Stem Cell Niche in the Small Intestine with Femtosecond Laser Photodisruption, Jiahn Choi ¹ , Daniel J. Joe ² , Poornima Gadamsetty ¹ , Nikolai Rakhilin ² , Pengcheng Bu ^{1,2} , Steven Lipkin ³ , Xiling Shen ^{2,1} , Nozomi Nishimura'; 'Biomedical Engineering, Cornell Univ., USA; ² Electrical Engineering, Cornell Univ., USA; ³ Division of Gastroenterol- ogy, Depts. of Medicine and Genetic Medicine, Weill Cornell Medical College, USA. In the stem cell niche, contact between different cells is thought to regulate stem cell self-renewal. We investigate how lost stem cells are replaced by ablating cells with in vivo femtosecond laser	FTu2E.2 • 11:00 Invited O Optical Frequency Comb Generators for Trace Gas Sensing, Adam J. Fleisher ¹ , David A. Long ¹ , Joseph T. Hodges ¹ , Kevin O. Douglas ¹ , Stephen Maxwell ¹ , David F. Plusquellic ¹ ; ' <i>NIST</i> , USA. Optical frequency comb generators for rapidly re-configurable trace gas sensing are demonstrated using high-bandwidth low-V _π electro-optic modulators and rapid-scannig microwave sources. These compact devices perform sensitive dual-comb spectroscopy with user-defined line spacing.

FTu2B.4 • 11:15 Invited C CMOS Compatible Photonic Crystal Nanobeam Cavity Sensors, Feng Liang¹, Qimin Quan¹; 'Harvard Univ., USA. The growing applications of nanoparticles in energy and healthcare demand new metrology techniques with improved sensitivity and requirement of lower sample concentration. We develop the CMOS compatible photonic crystal nanobeam cavities to size single nanoparticles.

FTu2A.3 • 11:30

Tuesday, 20 October

Designing Light-Matter Interactions with Trapped Atoms in Two Dimensional Photonic

Crystals Slabs, Juan Muniz¹, Su-Peng Yu¹, Andrew C. McClung¹, Michael J. Martin¹, Lucas S. Peng¹, Jonathan D. Hood¹, Akhisa Goban¹, Mingwu Lu¹, Chen-Lung Hung¹², H. Jeff Kimble¹, 'Inst. for Quantum Information and Matter, *Caltech*, USA; ²Physics Dept., Purdue Univ., USA. We describe two-dimensional photonic crystals that support atom trapping as well as strong radiative coupling to guided modes. We explore tailoring interactions between atoms and photons, as well as ongoing experimental progress. FTu2C.3 • 11:30 Eye-Tracked Extraocular Camera for Retinal

Prostheses, Furkan E. Sahin¹, Ben P. McIntosh¹, Patrick J. Nasiatka¹, James D. Weiland¹, Mark S. Humayun¹, Armand R. Tanguay¹; 'Univ. of *Southern California, USA*. The optical design and system integration of an eye-tracked wideangle extraocular camera for use in conjunction with intraocular retinal prostheses is described. This integrated system is capable of restoring foveation for those with retinal prostheses.

view (FOV) of ~500 μm. FTu2D.4 • 11:30

photodisruption in mice.

FTu2D.3 • 11:15 **D** WiO

Spectrally encoded confocal microscopy at

the 1.9-μm wavelength window, Sisi Tan¹, Xiaoming Wei¹, Shanhui Xu², Zhongmin Yang²,

Bowen Li¹, Kenneth K. Y. Wong¹; ¹The Univ.

of Hong Kong, Hong Kong; ²Inst. of Optical

Communication Materials and State Key Lab

of Luminescent Materials and Devices, South China Univ. of Technology, China. We demon-

strate a spectrally encoded confocal microscopy

(SECM) system at 1.9 µm using broadband supercontinuum (SC) source, which is capable of imaging at resolution of ~2 µm and field of

Hyperspectral Imaging of Thick Tissues based on Optical Sectioning Microscopy, Yu John Hsu¹, Chien-Hsiang Huang¹, Liang-Jhih Wang¹, Szu-Yu Chen¹; 'National Central Univ., Taiwan. An optical sectioning microscopic system was introduced for wide-field hyperspectral microscopy to improve the axial resolution in thick tissues applications. Within thick turbid specimens such as an intact leaf, such technique was successfully demonstrated.

FTu2E.3 • 11:30 D

Dual-Comb Spectroscopy with Difference-Frequency-Generated Mid-Infrared Frequency Combs, Daniel Maser^{1,2}, Flavio C. Cruz^{1,3}, Gabriel Ycas¹, Todd Johnson^{1,4}, Andrew Klose¹, Fabrizio Giorgetta¹, Laura C. Sinclair¹, lan Coddington¹, Nathan R. Newbury¹, Scott Diddams¹: ¹National Inst. of Standards & Tech. USA; ²Dept. of Physics, Univ. of Colorado Boulder, USA; ³Instituto de Fisica Gleb Wataghin, Universidade Estadual de Campinas, Brazil: ⁴Dept. of Physics, Saint Johns Univ., USA. Two mid-infrared frequency combs with average powers of up to 0.5 W were produced via difference frequence generation. Absorption in acetylene C₂H₂ was measured using mid-infrared dual-comb spectroscopy.

Sacramento

FTu2F • General Quantum Electronics I-

5.5 W of Diffraction-Limited Green Light Generated by

SFG of Tapered Diode Lasers in a Cascade of Nonlinear

Crystals, Anders K. Hansen¹, Ole Jensen¹, Peter Andersen¹,

Paul Michael Petersen¹; ¹Dept. of Photonics Engineering,

Technical Univ. of Denmark, Denmark. Diode-based high

power visible lasers are perfect pump sources for, e.g., tita-

nium-sapphire lasers. The combination of favorable scaling

laws in both SFG and cascading of nonlinear crystals allows

access to unprecedented powers in diode-based systems.

Hillsborough

Piedmont

LS

LTu2G • Precision Laser Spectroscopy I— Continued

LTu2G.2 • 11:00 Invited

LTu2H • Novel Fiber Lasers I—Continued

Precision Measurements of Hydrogen and Helium n=2 Fine Structure for Determining the Proton Size and the Fine-Structure Constant, Eric A. Hessels'; 'York Univ., Canada. Precision measurements of n=2 hydrogen and helium will lead to precise determinations of the charge radius of the proton and the fine-structure constant. A new frequency-offset separated-oscillatory-field technique is employed. Shifts due to quantum-mechanical interference effects will be discussed.

LTu2H.2 • 11:00 Invited

Multi-Core Fiber Lasers, Axel Schulzgen¹, James Anderson¹, Clemence Jollivet¹, Amy Van Newkirk¹, Kay Schuster², Stephan Grimm²; 'CREOL, the College of Optics and Photonics, Univ. of Central Florida, USA; ²Leibniz Inst. of Photonic Technology e.V., Germany. The operation of multicore fiber lasers with and without supermode selection will be discussed. Supermode specific gain measurements and roundtrip losses, as well as the dynamic behavior of multi-core fiber lasers will be presented.



FTu2F.4 • 11:15

FiO

Continued

FTu2F.3 • 11:00

Transverse Mode "Polarization" in Optical Beams, Xiao-Feng Qian¹, Tanya Malhotra¹, James Maslek¹, Nick Vamivakas¹, Joseph Eberly¹; ¹Univ. of Rochester, USA. The concept of generalized "polarization" of transverse spatial modes for a classical light beam is introduced and is experimentally observed systematically through a novel tomographic measurement.



FTu2F.5 • 11:30

Entanglement Constraints in Multi-Qubit Systems, Xiao-Feng Qian¹, Miguel Alonso¹, Joseph Eberly¹; ¹Univ. of Rochester, USA. We observe a novel type of multi-party entanglement constraint relations for arbitrary N-qubit pure state systems. A multi-dimensional geometric representation of such relations is presented.

LTu2G.3 • 11:30 Invited

1S-3S Hydrogen CW Laser Spectroscopy, Sandrine Galtier¹, Helene Fleurbaey¹, Simon Thomas¹, Pierre Clade¹, Saida Guellati¹, Lucile Julien¹, Francois Biraben¹, Francois Nez¹; ¹Laboratoire Kastler Brossel, UPMC-Sorbonne Universités, CNRS, ENS-PSL Research Univ., Collège de France, France. The proton charge radius (r_p) puzzle has disrupted the test of quantum electrodynamics calculations from hydrogen spectroscopy. Currently, depending on the velocity distribution, two contradictory values of r_p can be extracted from our hydrogen experiment.

LTu2H.3 • 11:30 Invited

Infrared Fiber Materials, Sources and Components, Rafael R. Gattass¹, Rajesh Thapa², Frederic H. kung³, Lynda Busse¹, Jesse Frantz¹, L. Brandon shaw¹, Jasbinder Sanghera¹; ¹US Naval Research Lab, USA; ²Sotera Defense Solutions, USA; ³Univ. Research Foundation, USA. We review the physical and optical properties of chalcognide fibers, recent advances in chalcogenide fiber technology, sources and devices fabricated from these fibers.

California	Valley	Crystal	Gold	Empire
		FiO		
FTu2A • Integrated Quantum Optics I—Continued	FTu2B • Photonic Crystals— Continued	FTu2C • Wearable Imaging Optics—Continued	FTu2D • Microscopy I—Continued	FTu2E • Engineered Frequency Combs in Passive and Active Systems I—Continued
FTu2A.4 • 11:45 Integrated Frequency Comb of Time-Bin Entangled Photon Pairs, Christian Reimer ¹ , Michael Kues ¹ , Piotr Roztocki ¹ , Benjamin Wet- zel ^{1,8} , Fabio Grazioso ¹ , Yaron Bromberg ⁷ , Brent E. Little ² , Sai T. Chu ³ , David J. Moss ^{1,4} , Lucia Caspani ^{1,5} , Roberto Morandotti ^{1,6} ; 'INRS-EMT, Canada; *Xi'an Inst. of Optics and Precision Mechanics of CAS, , China; ³ Dept. of Physics and Material Science, City Univ. of Hong Kong, China; ⁴ School of Electrical and Computer Engineering, RMIT Univ., Australia; ⁵ School of Engineering and Physical Sciences, Heriot-Watt Univ., UK; ⁴ Inst. of Fundamental and Frontier Sciences, Univ. of Electronic Science and Technology of China, China; ⁷ Dept. of Applied Physics, Yale Univ., USA; ⁶ Dept. of Physics and Astronomy, Univ. of Sussex, UK. We report the generation of multiple-frequency time-bin en- tangled photon pairs from a single integrated CMOS-compatible microring resonator. En- tanglement on five channel pairs with visibilities above 82.6% (93.8% background-corrected) is demonstrated.	FTu2B.5 • 11:45 WiO Polarization splitter in silicon-on-insulator photonic crystal; design and simulation, Preeti Rani ¹ , Reena Dalal ¹ , Yogita Kalra ¹ , Ravindra K. Sinha ¹ ; <i>'Delhi Technological Univ., India.</i> In this paper, we report the polarization splitter based on coupling length in a two dimensional hon- eycomb photonic crystal slab. The simulation results show that the proposed design behaves as polarization mode splitter.	FTu2C.4 • 11:45 Plarizer and Diffusing Retroreflector Inte- gration for Hands-Free Switching Telescopic Contact Lens, Glenn M. Schuster ¹ , Scott Cook- son ² , Arthur Zhang ² , William Meyers ³ , Joseph E. Ford ¹ ; ¹ Univ. of California, San Diego, USA; ² Innovega Inc, USA; ³ Paragon Vision Sciences, USA. We describe the fabrication and character- ization of telescopic scleral contact lenses with embedded orthogonal polarizers over the 1x and 2.8x paths, and a diffusing retro-reflector, used with liquid crystal shutter glasses providing wink-controlled hands-free switching.	Fu2D.5 • 11:45 WiO Hyperspectral Multiphoton Microscopy: Demonstration of 48-channel Imaging In Vivo, Amanda Bares ¹ , Steven Tilley ² , Peter S. Doerschuk ¹ , Chris B. Schaffer ¹ ; 'Cornell Univ., USA; ² Biomedical Engineering, Johns Hopkins Univ., USA. We constructed a hyperspectral multiphoton microscope that records 48 chan- nels of excitation/emission spectral data per pixel, while remaining insensitive to optical scattering. We demonstrate imaging of multiple spectrally overlapping fluorophores in mouse cortex, <i>in vivo</i> .	FTu2E.4 • 11:45 Influence of Raman scattering on Kerr frequency comb in a silica toroidal microcav- ity, Takumi Kato', Tomoya Kobatake', Zhelun Chen', Ryo Suzuki', Takasumi Tanabe'; 'Keio Univ., Japan. We investigate that the interac- tion between four-wave mixing and Raman scattering in a high-Q silica microcavity with a split-step algorithm. Raman-effect dominant states occur between a transition of stable Kerr comb formation.

12:00–13:00 Lunch Break (on your own) and Unopposed Exhibit Only Time, Exhibit Hall, Imperial Ballroom

12:00–13:30 Optical Material Studies Technical Group Workshop, Cupertino

12:00–13:30 Better than Fakin' it Good: Multifunctional Bioreplication, Fairfield

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Reminder: FiO/LS 2015 Program now available in mobile formats! Visit www.frontiersinoptics.com for more information.	FTu2F • General Quantum Electronics I— Continued	LTu2G • Precision Laser Spectroscopy I— Continued	LTu2H • Novel Fiber Lasers I—Continued
12	2:00–13:00 Lunch Break (on your own) and Unopp	osed Exhibit Only Time, Exhibit Hall, Imperial B	allroom

12:00–13:30 Optical Material Studies Technical Group Workshop, Cupertino

12:00–13:30 Better than Fakin' it Good: Multifunctional Bioreplication, Fairfield

California	Valley	Crystal	Gold	Empire	
	FiO				
13:00–14:30 FTu3A • Nonlinear Optics in Micro or Nano-Optical Structures IV Presider: Richard Stevenson; Toshiba Corp, UK	13:00–14:30 FTu3B • Novel Communications Technologies Presider: Syed Murshid; Florida Inst. of Technology, USA	13:00–14:30 FTu3C • Photonic Structures for Energy D Presider: Peter Rakich; Yale Univ., USA	13:00–14:30 FTu3D • Microscopy II Presider: Chris Schaffer, Cornell Univ., USA	13:00–14:30 FTu3E • Engineered Frequency Combs in Passive and Active Systems II Presider: Ian Coddington, NIST, USA	
FTu3A.1 • 13:00 Invited Quantum Metamaterials Based on Nonlinear Superconducting Resonators , Alexandre Kar- pov ¹ ; 'National Un.of Science and Techn (MISIS), Russia. We will present experimental study of SQUID array based quantum superconductive metamaterials. The cryogenic Laser Scanning Microscope technique gives an insight to con- firm a coherent response of the SQUID-based microwave resonator arrays and its tunability.	FTu3B.1 • 13:00 Geometric Phase Shifter using Optical Wave- plates for Microwave Photonics, Tomoyuki Uehara ¹ , Kenichiro Tsuji ¹ , Noriaki Onodera ¹ ; 'National Defense Academy of Japan, Japan. We demonstrate an RF geometric phase shifter using optical wave plates and optical polarizer for photonically generated microwave signal. The RF phase generated from orthogonally polarized lights was shifted from 0 to 360 degrees.	FTu3C.1 • 13:00 Tutorial C Nanophotonics for Energy and Information Applications, Shanhui Fan'; 'Stanford Univ., USA. We discuss some of the recent develop- ments of nanophotonics for information and energy applications. As examples, we discuss the use of dynamic modulation for the purpose of creating non-reciprocal response as well as an effective gauge field for photons. We will also discuss the use of photonic structures for thermal radiation control, leading in particular to the demonstration of passive radiative cooling.	FTu3D.1 • 13:00 WiO Plasmonic nanoisland-based cell microscopy for sub-diffraction-limited imaging, Taehwang Son', Youngjin Oh', Wonju Lee', Donghyun Kim'; 'School of Electrical and Electronic Engineering, Yonsei Univ, Korea. We have ex- plored sub-diffraction-limit cellular imaging using blocked nanoislands based on surface plasmon localization. Intracellular actin filaments were visualized on nanoislands and resolved by localized near-fields in the range of 100-150 nm.	FTu3E.1 • 13:00 Tutorial C Mid-Infrared and THz Quantum Cascade Laser Frequency Combs, Jérôme Faist ¹ ; ¹ ETH Zurich, Switzerland. The locking mechanism of broadband mid-infrared and THz Quantum cascade frequency combs will be explained. Octave-spanning frequency, dispersion correc- tion as well as proof of principle spectroscopy experiments will also be discussed.	
	FTu3B.2 • 13:15 Proposal of a Bi-directional Fiber-To-The- Antenna System for Microwave Signal Distribution, Ana G. Correa-Mena ¹ , Pablo Hernandez-Nava ¹ , Alejandro García-Juárez ² , Armando Rojas-Hernández ² ; 1/NAOE, - Puebla, Mexico; ² Universidad de Sonora, Mexico. We experimentally describe a bi-directional fiber-to-the-antenna communication system for microwave signals distribution. The uniqueness of this work is that only an optical source was used for this goal.	Shanhui Fan is a Professor of Electrical Engi-	FTu3D.2 • 13:15 Laser Scanning Stereomicroscopy with Bessel Beams, Yan Long Yang ¹ ; ¹ Xi'an Inst. of Optics and Precision Mechanics, Chinese Academy of Sciences, China. A laser scanning fluorescence microscopy is designed with both the extended depth of field and stereoscopic ability, which allow us to view the whole volume of specimen at a speed of about 1 to several volumes per second directly with NVIDIA shutter glasses without post image processing.	Jérôme Faist obtained his Bachelor and Ph.D. in Physics, in the group of Prof. FK Reinhart from the Swiss Institute of Technology in Lausanne in 1985, 1989 respectively. After a post-doc in	
FTu3A.2 • 13:30 Invited Quantum Optical Measurements with Clas- sical Nonlinear Optics, John E. Sipe ¹ , Marco Liscidini ² ; ¹ Dept. of Physics, Univ. of Toronto, Canada; ² Dipartimento di Fisica, Universita degli Studi di Pavia, Italy. The quantum-correlated photon pairs that would be generated by a nonlinear optical device, were it operated in the quantum regime, can be characterized by nonlinear optical experiments done on the device in the classical regime.	FTu3B.3 • 13:30 WiO Multi-mode QKD over a Marine FSO Channel, Alyssa Jenkins ¹ , Ivan Djordjevic ¹ , Mark Neifeld ¹ , ¹ Univ. of Arizona, USA. We study the perfor- mance of the BB84 quantum key distribution technique in a marine environment. We quantify effects of loss, scattering, and turbulence on secret key rate and extend single channel results to multi-mode encodings.	Shainful Pari is a Professor of Electrical Engineering, neering, and the Director of the Edward L. Ginzton Laboratory, at the Stanford University. He received his Ph. D in 1997 in theoretical con- densed matter physics from MIT. His research interests are in nanophotonics. He has published over 350 refereed journal articles and has given over 270 invited talks, and was granted 53 US patents. Prof. Fan received a NSF Career Award, a David and Lucile Packard Fellowship , the National Academy of Sciences Award for Initia- tive in Research, and the Adolph Lomb Medal from the Optical Society. He is a Fellow of APS,	FTu3D.3 • 13:30 C Automation of Interferometric Synthetic Aperture Microscopy, Yang Xu', Yuan-Zhi Liu', Stephen A. Boppart', Paul S. Carney', 'Univ of Illinois at Urbana-Champaign, USA. We present an automated algorithm framework for determining the optimal parameters for interferometric synthetic aperture microscopy (ISAM). It significantly lowers the background requirement for operating ISAM machines, while achieving near-optimal ISAM reconstruction on	In 1985, 1969 respectively. After a post-doc in IBM Rueschlikon (89-91), he joined F. Capasso's group in Bell Laboratories in 1991 where he worked first as a post-doc and then as a Member of Technical Staff. From 1997 to 2007, he was professor in the physics institute of the University of Neuchätel. In 2007, he became professor in the institute for quantum electronics of the ETH Zurich. His central role in the invention and first demonstration of the quantum cascade (QC) la- ser in 1994 was recognised by the IEE premium (1995), the IEEE/LEOS William Streifer award (1998), the Michael Lunn award (1999), the ISCS	

OSA, SPIE, and IEEE.

OCT images.

"Young scientist award" (1999), and the Swiss National Latsis Prize (2003). His present interests are the development of high performance QC lasers in the Mid and Far-infrared and the physics of coherence in intersubband transitions in the presence of strong magnetic fields.

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13:00–14:30 FTu3F • Lasers and Electro-optics Presider: Zhimin Shi, Univ. of Rochester, USA

FTu3F.1 • 13:00 Invited WiO

Integrated Hybrid Microcavities for Low Threshhold Lasers, Andrea M. Armani¹, Ce Shi¹, Nishita Deka¹, Kelvin Kuo¹; ¹Univ. of Southern California, USA. By integrating new gain into hybrid ultra-high-Q cavities, two types of low-threshold optically-pumped lasers are demonstrated. The Ti-enhanced Raman laser and the gold nanorod plasmonic laser both have sub-mW thresholds.

13:00–14:30 FTu3G • General Quantum Electronics II Presider: Alexandre Karpov, NIST, USA

FTu3G.1 • 13:00 Invited

Computational Optical Imaging For Super-resolution Microscopy And Sensing Through Complex Media, Rafael Piestun¹; 'Univ. of Colorado at Boulder, USA. Optical computational imaging seeks enhanced performance and new functionality by the joint design of illumination, optics, detectors, and reconstruction algorithms. Two remarkable examples discussed here enable overcoming the diffraction limit and imaging through complex media.

13:00–14:30 LTu3H • Nonlinear and Spectroscopic Imaging II Presider: Michelle Sander; Boston Univ., USA

LTu3H.1 • 13:00 Invited

Nonlinear Optical Imaging in Art Conservation and Heritage Science, Martin C. Fischer¹, Tana Villafana¹, William Brown², John Delaney³, Warren S. Warren¹; ¹Duke Unix, USA; ²North Carolina Museum of Art, USA; ³National Gallery of Art, USA. Pump-probe microscopy can extract molecular and structural contrast with high spatial resolution even in thick, scattering samples. We will discuss the technique's principle and applications for imaging historic paintings and other cultural heritage objects.

LS

13:00–14:30 LTu3I • Novel Fiber Lasers II Presider: Jason Auxier; US Naval Research Lab, USA

LTu3I.1 • 13:00 Invited

Q-switched Fiber Laser Based on the Kerr Effect of Multimode Interference Effect, Wei Shi¹; ¹Tianjin Univ., China. We demonstrated an all-fiber passively Q-switched Er-Yb codoped fiber laser using a single mode-multimode-single mode fiber structure based on the multimode interference effect. To the best of our knowledge, this is the first demonstration of the Q-switched fiber laser based on a SMS structure.

FTu3F.2 • 13:30

Long term carrier-envelope-phase stabilization of a terawatt-class Ti:Sapphire laser, Adam M. Summers¹, Benjamin Langdon^{2,3}, Jon Garlick³, Xiaoming Ren^{4,1}, Derrek Wilson¹, Stefan Zigo¹, Matthias Kling^{5,1}, Shuting Lei⁶, Christopher Elles⁷, Eric Wells⁹, Erwin Poliakoff⁸, Kevin Carnes¹, Vinod . Kumarappan¹, Itzhak Ben-Itzhak¹, Carlos Trallero-Herrero¹; ¹J. R. Macdonald Lab, Kansas State Univ., USA; ²Crunch Technologies, USA; ³Kapteyn-Murnane Labs Inc, USA; ⁴CREOL and Dept. of Physics, Univ. of Central Florida, USA; ⁵Physics Dept., Ludwig-Maximilians-Universitat, Germany; ⁶Industrial and Manufacturing Systems Engineering, Kansas State Univ., USA; ⁷Dept. of Chemistry, Univ. of Kansas, USA; ⁸Dept. of Chemistry, Louisiana State Univ., USA; 'Dept. of Physics, Augustana College, USA. We demonstrate a terawatt class Ti:Sapphire laser, 20 mJ pulse energy, 26 femtosecond pulse duration, 1kHz repetition rate, with Carrier-envelope-phase (CEP) stabilized within 300 mrad RMS, measured single shot over 9 hours

FTu3G.2 • 13:30

Verification of a Heralded, Two-Photon Fock State with a Gang of Detectors, Roger A. Smith¹, Dileep V. Reddy¹, Dashiell L. Vitullo¹, Michael G. Raymer¹; ¹Univ. of Oregon, USA. We propose an experimental method for measuring two-photon Fock states using a gang of detectors and demonstrate the creation of heralded, two-photon Fock states of light.

LTu3H.2 • 13:30 Invited

In Vivo Spectroscopic Imaging by Retrieving Stimulated Raman Signal from Highly Scattered Photons, Chien-Sheng Liao¹, Ji-Xin Cheng¹, Pu Wang¹; ¹Purdue Univ., USA. We demonstrate microsecond vibrational spectroscopic imaging by spatial frequency-multiplexing and single photodiode detection of stimulated Raman signals. Compared to the spectrometer setting, we improved the photon-collection efficiency by 200 times for scattering systems.

LTu3I.2 • 13:30 Invited

Fiber-based Doppler Lidar for Vector Velocity and Altitude Measurements, Farzin Amzajerdian¹, Diego F. Pierrottet², Glenn D. Hines¹, Larry B. Petway¹, Bruce W. Barnes¹; ¹NASA Langley Research Center, USA; ²Coherent Applications, Inc., USA. A coherent Doppler lidar capable of providing accurate velocity and altitude data has been developed and demonstrated for future NASA missions to the solar system bodies requiring precision navigation and controlled soft landing.

California	Valley	Crystal	Gold	Empire	
FiO					
FTu3A • Nonlinear Optics in Micro or Nano-Optical Structures IV— Continued	FTu3B • Novel Communications Technologies—Continued	FTu3C • Photonic Structures for Energy—Continued	FTu3D • Microscopy II—Continued	FTu3E • Engineered Frequency Combs in Passive and Active Systems II—Continued	
	FTu3B.4 • 13:45 C Characterization of Tellurite Fiber Samples Doped with Erbium and Ytterbium for Broad- band Amplification, Thisien G. Montes', Jorge D. Marconi ² , Enver F. Chillcce', Luiz C. Barbosa', Aldario C. Bordonalli', 'Univ. of Campinas, Brazil; 'Federal Univ. of ABC, Brazil. A spectral characterization of erbium and ytterbium doped tellurite fibers pumped at 980-nm is presented. Samples offered up to 70-nm ASE bandwidth around 1550 nm and over 20-dB potential am- plification between 1530 and 1585 nm.	FTu3C.2 • 13:45 Photonic Crystal Devices for Energy Applica- tions, Jeremy N. Munday ¹ , Yunlu Xu ¹ ; ¹ Univ. of Maryland at College Park, USA. Photonic crystals can be used to modify photon absorption and emission rates. Here we show how photonic crystals can yield higher power conversion ef- ficiency in solar energy converters through an effective bandgap modification.	FTu3D.4 • 13:45 Photothermal imaging for nanoparticle characterization using single element interferometer, Yuki Nagata ¹ , Yasuhiro Mizutani ² , Tetsuo Iwata ¹ , Yukitoshi Otani ³ ; 'Tokushima Univ., Japan; ² Osaka Univ., Japan; ³ Utsunomiya Univ., Japan. A photothermal imaging microscope for single metal nanoparticles using single element interferometer has been developed. In this report, different diameters of the gold nanoparticles were discriminated by measuring the phase of photothermal signals.	FTu3E.2 • 13:45	
FTu3A.3 • 14:00 Quantum-Coherently Assisted Deep-UV Localization of Light in Active Plasmonic Het- erostructures, Kosmas Tsakmakidis ¹ , Pankaj K. Jha ¹ , Yuan Wang ¹ , Xiang Zhang ¹ ; ¹ UC Berkeley, USA. We introduce a new method to localize lightwaves. We show how the interaction of a gain medium with a planar deep-UV plasmonic heterostructure, at its zero-v _a point, strongly localizes light. A quantum-coherent drive pro- vides a means to control the localization and dramatically improve the dynamics.	FTu3B.5 • 14:00 C Chaotic Semiconductor Lasers with Time-de- lay Signatures Suppressed by Feedback from Optimized FBGs, Song-Sui Li ¹ , Xiao-Zhou Li ¹ , Jun-Ping Zhuang ¹ , Sze-Chun Chan ^{1,2} , ¹ Dept. of Electronic Engineering, City Univ. of Hong Kong, China; ² State Key Lab of Millimeter Waves, City Univ. of Hong Kong, China. Chaotic dynamics is investigated in a semiconductor laser with fiber Bragg grating (FBG) feedback. By optimizing the FBG bandwidth and detuning frequency from the laser, time-delay signature suppression by over 10 times is observed experimentally.	FTu3C.3 • 14:00 WiO Fabrication and Characterization of Solar Su- percapcitors Integrated with a Laser Scribed Graphene Oxide film, Litty Thekkekara ¹ , Bao- hua Jia ¹ , Yinan Zhang ¹ , Ling Qiu ² , Dan Li ² , Min Gu ¹ ; ¹ Swinburne Univ. of Technology, Australia; ² Dept. of Materials Engineering, Monash Univ, Australia. An on-chip concept of supercapacitor electrical energy storage integrated with solar cells using thin-film graphene oxide was dem- onstrated. The solar supercapacitor showed a 62% columbic efficiency with non-degradation in the solar cell performance.	FTu3D.5 • 14:00 O Optical Sectioning in Interferometric Cross- Polarised Microscopy Towards Biological Im- aging, Benjamin Miles ¹ , Henkjan Gersen ¹ ; ¹ Univ. of Bristol, UK. Experimentally and theoretically characterising Interferometric Cross-Polarisation Microscopy presents strong evidence of the abil- ity to optically section. This feature combined with high resolution and extinction ratios, sug- gests unique potential for imaging birefringent structures in living cells.	Ftu3E.3 • 14:00 C Hanbury Brown and Twiss Interferometry with Twisted Light, Omar S. Magana Loaiza ¹ , Mo- hammad Mirhosseini ¹ , Robert M. Cross ¹ , Seyed Mohammad Hashemi Rafsanjani ¹ , Robert W. Boyd ^{1,2} ; ¹ UofR, USA; ² Physics, Univ. of Ottawa, Canada. We demonstrate that chaotic fluctua- tions of intensity give rise to the formation of correlations in the orbital-angular-momentum components and angular positions of thermal light. These correlations are manifested through Hanbury-Brown-and-Twiss interference in the orbital-angular-momentum basis.	
FTu3A.4 • 14:15 Divide and Conquer: Counting Photons on an Integrated Platform, Armando P. Leija ² , René Heilmann ¹ , Jan Sperling ³ , Markus Gräfe ¹ , Mat- thias Heinrich ¹ , Stefan Nolte ¹ , Werner Vogel ³ , Alexander Szameit ¹ , ¹ Friedrich-Schiller-Univer- sität Jena, Germany; ² Inst. of Applied Physics, Abbe Center of Photonics, Friedrich-Schiller- Universität Jena, Germany; ³ Arbeitsgruppe Quantenoptik, Inst. für Physik, Universität Rostock, Germany. We experimentally demon- strate a fully integrated photon-counting device based on a divide-and-conquer technique us- ing linear optics in combination with standard on-off detectors.	FTu3B.6 • 14:15 Imformation processing using an autonomous all-photonic reservoir computer based on coherently driven passive cavities, Quentin Vinckier ¹ , Francois Duport ¹ , Marc Haelterman ¹ , Serge Massar ² ; 'OPERA-Photonique, ULB (Uni- versité Libre de Bruxelles), Belgium; ² Laboratoire d'Information Quantique, ULB (Université Libre de Bruxelles), Belgium. We study a realistic numerical model of an autonomous all-optical neural network based on two coherent optical cavities in order to demonstrate its high poten- tial for high-speed signal processing with low power consumption.	FTu3C.4 • 14:15 Design and Analysis of Low Loss Highly Ef- ficient Light Trapping Structure for GaAs Thin Film Solar Cells using Photonic Crystals as Diffraction Grating, Nikhil Deep Gupta ¹ , Vijay Janyani ¹ , Ghanshyam Singh ¹ , Hiroyuki Tsuda ² ; ¹ Malaviya National Inst. of Technolog, India; ² Electrical and Electronics Dept., Keio Univ., Japan. The paper demonstrates performance improvement of photonic crystal diffraction grat- ing based GaAs thin film solar cell and shows that light trapping structure contributes more to the efficiency enhancement of thinner cells.	FTu3D.6 • 14:15 C STED Imaging by Using Hollow Bessel Beam, Wentao Yu ¹ , Ziheng Ji ¹ , Xusan Yang ² , Zibo Gong ¹ , Yunfeng Xiao ^{1,3} , Peng Xi ² , Kebin Shi ^{1,3} , 'State Key Lab for Mesoscopic Physics, School of Physics, Peking Univ., China; ² Dept. of Biomedi- cal Engineering, College of Engineering, Peking Univ., China; ³ Collaborative Innovation Center of Quantum Matter, China. We report a STED microscope by using Bessel beam. Improved lat- eral resolution of deep-imaging at 84µm-depth was observed as 150nm, with comparison to a standard STED imaging resolution of 275nm measured at the same depth.	FTu3E.4 • 14:15 C Bandwidth Control in 5-µm Pulse Genera- tion by Double-Chirped Optical Parametric Amplification, Scott Wandel ¹ , Guibao Xu ¹ , Yanchun Yin ¹ , Ming-wei Lin ¹ , Igor Jovanovic ¹ ; ¹ Pennsylvania State Univ., USA. We simulate and experimentally demonstrate a versatile and ef- ficient method to control the spectral bandwidth of short mid-infrared pulses produced by optical parametric amplification.	
	14:30–16:00 JTu4A •	• Joint FiO/LS Poster Session I, Exhibit	Hall, Imperial Ballroom		

14:30–16:00 Unopposed Exhibit Only Time, Exhibit Hall, Imperial Ballroom Coffee Break (14:30-15:00)

14:30–16:00 OSA Student Chapter Competition, Exhibit Hall, Imperial Ballroom

Glen Ellen	Sacramento	Hillsborough	Piedmont
FiO		L	S
FTu3F • Lasers and Electro-optics— Continued	FTu3G • General Quantum Electronics II— Continued	LTu3H • Nonlinear and Spectroscopic Imaging II—Continued	LTu31 • Novel Fiber Lasers II—Continued
FTu3F.3 • 13:45 Withdrawn.	FTu3G.3 • 13:45 WiO Ho:YAG Rod Amplifier For High Order Vortex Modes, Yuan Li ¹ , Zeyu Zhang ¹ , Wenzhe Li ¹ , Jerome Miller ¹ , Eric Johnson ¹ ; ¹ The Holcombe Dept. of Electrical and Computer Engineer- ing, Clemson Univ., USA. The amplification of Laguerre- Gaussian (LG) modes with orbital angular momentum is demonstrated in a Ho:YAG rod amplifier. Simulations are also carried out for verifying the experimental data and predicting the potential for high gain.		
FTu3F.4 • 14:00 WiO Effect of Fe impurity on fused silica surface damage in- duced by 355nm laser pulse, Hongjie Liu'; 'China Academy of Engineering Physics, Research Center of Laser Fusion , China. The samples polished by cerium oxide, ferric oxide or processed by magnetorheological finishing show that not only Ce but also Fe element has a serious influence on laser-induced native damage.	FTu3G.4 • 14:00 Controlling Directionality of Radiation Through Separable Bound States in the Continuum, Nicholas Rivera ¹ , Chia Wei Hsu ³ , Bo Zhen ¹ , Hrvoje Buljan ² , John Joannopoulos ¹ , Marin Soljacic ¹ ; ¹ MIT, USA; ² Univ. of Zagreb, Croatia; ³ Vale Univ., USA. We demonstrate a general class of bound states in the continuum in separable systems that are realizable and show that tailored perturbations of these BICs allow control over the directionality and dimensionality of resonant radiation.	LTu3H.3 • 14:00 Invited Broadband CARS - Instrumentation, Quantitation, and Application, Marcus T. Cicerone ^{1,2} , Charles Camp ¹ , Young J. Lee ¹ ; ¹ Biomaterials, National Inst. of Standards and Technol- ogy, USA; ² IPST, Univ. of Maryland - College Park, USA. I will discuss capabilities and applications of broadband coherent anti-Stokes Raman scattering (BCARS) microscopy, focus- ing on optimized excitation paradigms, quantitative signal extraction, and applications in investigations of tissues and small organisms.	LTu3I.3 • 14:00 Invited Challenges of Near-Marine Boundary Layer Atmospheri and Turbulence Testing and Modeling, Tariq Manzur' Joshua Olson ² , Nasser Peyghambarian ² , Arturo Chavez Pirson ² ; 'NAVSEA Naval Undersea Warfare Ctr, USA; ² Univ of Arizona, USA. Abstract not available.
FTu3F.5 • 14:15 Metamaterial Resonators for Dynamic Spatial Millimeter- Wave Modulators, Daniel L. Marks ¹ , David R. Smith ¹ ; ¹ Duke Univ., USA. Many phase spatial modulators exist at optical frequencies such as liquid crystal cells. We present an alternative for millimeter-waves based on metamaterial resonators that produces strong phase modulation from a small tuning range.	FTu3G.5 • 14:15 High-power, picosecond, 10 μm pulses via compression of a laser beat-wave in GaAs , Jeremy Pigeon ¹ , Sergei Tochitsky ¹ , Chan Joshi ¹ ; <i>¹UCLA</i> , USA. We produce a train of high-power, 2 ps, 10 um laser pulses by multiple-four-wave- mixing compression of a 106 GHz CO ₂ laser beat-wave in GaAs. The possibility of generating high-power, 300 fs, mid-IR pulses is discussed.		
	14:30–16:00 JTu4A • Joint FiO/LS Poste	er Session I, Exhibit Hall, Imperial Ballroom	

14:30–16:00 Unopposed Exhibit Only Time, Exhibit Hall, Imperial Ballroom Coffee Break (14:30-15:00)

14:30–16:00 OSA Student Chapter Competition, Exhibit Hall, Imperial Ballroom

JOINT FIO/LS

14:30–16:00 JTu4A • Joint FiO/LS Poster Session I

JTu4A.1

Plasmonic NanoLenses: Size Based Sorting of Bacteria Like Bio-Particles, Xiangchao Zhu¹, Ahmet A. Yanik¹; ¹Baskin School of Engineering, Univ. of California, Santa Cruz, USA. We demonstrate that plasmonic metasurfaces enables size based sorting of single bacteria like bio-particles within a wide dynamic range of 0.1 µm to 1 µm, by merely modulating the light intensity.

JTu4A.2 WiO

Fuesday, 20 October

Generation of UV Laser Induced Point Defects in Fused Silica and Recombination by Oxygen Plasma, Xiaoyan Zhou'; 'China Acad Engin Physics, China. Laser induced point defects with different parameters on fused silica in atmosphere or vacuum were studied. These defects can react with oxygen plasma, which provides a new way to prolong the lifetime of fused silica in high-power laser system.

JTu4A.3

Measurements of the Optical Anisotropy Parameters of CaF₂, BaF₂ and SrF₂ Crystals, Alexey Yakovlev¹, Ilya Snetkov¹, Oleg Palashov¹; Inst. of Applied Physics RAS, Russia. The material constant – optical anisotropy parameter ξ of CaF₂, BaF₂ and SrF₂ crystals was measured at three wavelengths. The orientation of the crystallographic axes corresponding to minimum value of the thermally induced depolarization was obtained.

JTu4A.4

Ultraviolet Emissions of Tb³⁺ by Three-photon Upconversion Proces, Xiaojie Xue¹, Tonglei Cheng¹, Dinghuan Deng¹, Takenobu Suzuki¹, Yasutake Ohishi¹; ¹Toyota Technological Inst., Japan. Tb³⁺/Yb³⁺ co-doped NaYF₄ microcrystals show intense ultraviolet upconversion emissions. The emissions of Tb³⁺ at 323, 338, 352, and 368 nm are observed for the first time. They are generated by a three-photon upconversion process.

Research on Chromatic Properties of Higher Order Kinoform Lenses for THz Radiation, Karolina Wegzrynska¹, Agnieszka Siemion¹, Martyna Rachoń¹, Jaroslaw Suszek¹, Maciej Sypek¹; ¹Warsaw Univ. of Technology, Poland. The evaluation of chromatic properties of higher order kinoforms (phase structures with phase retardation of , p>1) in THz radiation was performed. Kinoforms of 1st and 2nd order were examined in paraxial and non-paraxial approaches.

JTu4A.6

JTu4A.5 WiO

How To Make Spins In Spin Hall Effect of Light Truly Separate, Bo Wang^{1,2}, Yan Li^{1,2}; ¹State Key Lab for Mesoscopic Physics,Dept. of Physics,Peking Univ., China; ²Collaborative Innovation Center of Quantum Matter, China. We theoretically demonstrate that the spin separation in spin Hall effect of light, even in anometers, can be intuitively observed.

JTu4A.7

Optoelectronic Systems for Measuring of Instantaneous Frequency of Radiosignals With an Amplitude-Phase Modulation of Optical Carrier, Aleksandr Vasiletc¹, Oleg Morozov¹, Gennady Morozov¹, Marat Nurgazizov¹, Anvar Talipov¹; ¹KNRTU-KAI, Russia. This article describes how to develop design principles of optoelectronic systems for radio signals instantaneous frequency measuring.

JTu4A.8

Super Long Distance of Self-similar Laser Beam Propagation in Medium with Nonlinear Absorption and Refraction, Vyacheslav Trofimov¹, Irina Zakharova¹; 'Lomonosov Moscow State Univ, Russia. 2D self-similar beam propagation in media with various types of nonlinear absorption and refraction is demonstrated by both computer simulation and analytical consideration. Under certain conditions, such beam propagates in this mode up to 8 diffraction lengths.

JTu4A.9

High Energy Level Excitation of Molecules due to Cascade Mechanism of Broadband THz Pulse Energy Absorption, Vyacheslav Trofimov¹, Dmitry Zagursky¹, Irina Zakharova¹; ¹Lomonosov Moscow State Univ., Russia. Low intense broadband THz pulse propagation in a medium is investigated. Physical mechanism of medium response spectrum broadening in comparison with the incident pulse spectrum is proposed.

JTu4A.10 WiO

Fabrication of Whispering Gallery Mode microresonators via Two-photon polymerization, Nathalia B. Tomazio¹; ¹São Carlos Inst. of Physics, Brazil. We propose the fabrication of microresonators which support Whispering Gallery Modes via Two-photon polymerization. The versality of this technique in fabricating microstructures with different properties opens the possibility for the development of a new generation of WGM resonators.

JTu4A.11 Withdrawn.

JTu4A.12

Random Flights in Turbid Media with Non-Uniform Optical Properties, Emiliano Teran¹, Eugenio Mendez²; ¹Deparment of Physics, Universidad Autonoma de Sinaloa, Mexico;

²Applied Physics Division, CICESE, Mexico. We present a theoretical study on the propagation of light in turbid media with non-uniform optical properties. We perform numerical calculations with uniform and non uniforms systems using Monte Carlo simulations to study the media.

JTu4A.13

Smartphone Based Real-Time Observation

Microscope, Yoon Tae Lim¹, Seonhee Hwang¹, Taeyoung Kang¹; ¹Nanobiophotonics, Korea (the Republic of). In this study, we designed microscope for real-time observation of the cells. This microscope uses a smartphone as detector. Therefore, we can observe in real time cells through the remote control of smartphone.

JTu4A.14 WiO

Concentration measurement of LDL cholesterol using extraordinary optical transmission sensor, Hyerin Song¹, Heesang Ahn¹, Wonju Lee², Kyujung Kim¹; ¹Pusan National Univ., Korea; ²Yonsei Univ., Korea. For measuring concentration of LDL cholesterol which elevates viscosity of blood vessel, we applied extraordinary optical transmission (EOT) sensor. We find out an optimum nanostructure which generates SPs to sensitively measure diverse concentrations of diluted cholesterol.

JTu4A.15

Influence of phosphor self-heating on halfdome-phosphor packaged pc-WLED output performance, Bao-Jen Shih¹, Shih-Chen Chiou¹, Yu-Hua Hsieh¹, Te-Yuan Chung¹; *National Central Univ., Taiwan.* Simulations using ray-tracing and FEA are done on estimating the temperature distribution in a half-dome-phosphor pc-WLED. The phosphor temperature is always higher than the LED chip. An experiment validated and showed the influence is non-negligible.

JTu4A.16 WiO Skin Erythema Assessment by an RGB Imaging

Device: a Clinical Study, Inga Saknite¹, Åleksejs Zavorins², Janis Spigulis¹; ¹Univ. of Latvia, Latvia; ²Dept. of Infectology and Dermatology, *Riga Stradins Univ., Latvia.* In this study, skin erythema assessment of 90 rosacea patients was estimated by a simple, Iow-cost RGB imaging device. A new erythema index assessment algorithm is proposed and clinically validated. Comparison with dermatologist's visual assessment shows high correlation.

JTu4A.17

Matrix for wave propagation through a Spiral

Phase Plate, Yisa S. Rumala¹; ¹City Univ. of New York, USA. A matrix formalism for wave propagation through a spiral phase plate (SPP) is presented. From the matrix, analytic equations describing the wave characteristics on the input and output planes of the SPP device is calculated.

JTu4A.18 WiO

Theoretical model of a biexcitonic quantum dot-microcavity system under the influence of a constant magnetic field, Luisa Fernanda Ramirez Ochoa¹, Herbert Vinck Posada¹; ¹Universidad Nacional de Colombia, Colombia. We study a quantum dot - microcavity system under the influence of an external magnetic field. We reproduce in a theoretical way the experimental reports and we study the entanglement properties.

JTu4A.19 WiO

Efficiency of THz Paper Optical Elements Depending on their Type and Manufacturing Techniques., Martyna Rachoń¹, Karolina Wegrzynska¹, Maciej Sypek¹, Jaroslaw Bomba¹, Artur Sobczyk^{1,2}, Jaroslaw Suszek¹, Agnieszka Siemion¹; ¹Physics, Warsaw Univ. of Technology, Poland; ²Geodesy and Cartography, Warsaw Univ. of Technology, Poland. Paper diffractive optical elements (ideal for fast prototyping) can be manufactured as binary, multiple-step or kinoform phase structures. We verify the overall efficiency depending on the structure type and the method of manufacturing.

JTu4A.20

Coupled optical and electrical numerical simulation for dual interface line grating Si thin film solar cells, Junfeng Qiao¹, Zhaoyu Zhang¹; 'Peking Univ, China. Coupled optical and electrical numerical simulation of Si thin film solar cells with front and back gratings structure are studied. Optimized results demonstrate both optical absorption and electrical response need to be taken into consideration.

JTu4A.21

Optimal Design of Chip-on-the-Tip Endoscope

with a Large Depth of Field, Wang Qiang^{1,2}, Lee Sukhan^{1,2}; ¹Sungkyunkwan Univ., Korea; ²Information and Communication Engineering, Intelligent Systems Research Inst., Korea. This paper presents a novel objective lens design for an endoscope of extremely small diameter in a Chip-on-the-Tip (COT) configuration. The design provides 8mm DOF at a close distance, with 140 degree FOV, while allowing to be compactly packaged into a 1 mm diameter and 3 mm length.

JOINT FiO/LS

JTu4A • Joint FiO/LS Poster Session I—Continued

JTu4A.22 WiO

The Effect of Oxygen Partial Pressures on the Formation of Cuprous Oxide Thin Films for Optoelectronic Applications, V. Vignesh¹, Rishabh Raj¹, Sonika Obheroi¹, R. Navamathavan¹, 'Vellore Inst. of Technology, Chennai, India. Our study delineates the optimal usage of high-quality Cu₂O thin films in optoelectronic applications by analyzing film deposition and crystallographic structure when contolled by sputtering parameters such as temperature, oxygen flow rate and deposition time.

JTu4A.23 WiO

Mechanically Tunable Thin Film High Refractive Index Contrast TiO₂-Gratings In Elastomeric Matrix, Philipp Gutruf¹, Eike Zellar¹, Sumeet Walia¹, Shruti Nirantar¹, Sharath Sriram¹, Madhu Bhaskaran¹; *I'RMIT*, Australia. A mechanically tunable grating is demonstrated by introducing titanium dioxide (TiO₂) nanoscale dot gratings into soft, elastomeric polydimethylsiloxane (PDMS). *In situ* diffraction angle measurements of strain-induced grating response are backed by finite element modelling.

JTu4A.24

Pulsed Laser Deposited GeTe-rich GeTe-Sb_Te_ Thin Films, Marek Bouska¹, Virginie Nazabal^{2,1}, Stanislav Pechev³, Alain Moreac², Jan Gutwirth⁴, Ludvik Benes⁵, Petr Nemec¹; ¹Dept. of Graphic Arts and Photophysics, Univ. of Pardubice, Czech Republic; ²Université de Rennes 1, France: ³Institut de Chimie de la Matière Condensée de Bordeaux, France; ⁴Dept. of General and Inorganic Chemistry, Univ. of Pardubice, Czech Republic; ⁵ Joint Lab of Solid State Chemistry, Univ. of Pardubice, Czech Republic. Pulsed laser deposition was employed for the fabrication of GeTe-Sb, Te, thin films with 6:1, 8:1, 10:1, and 12:1 (GeTe):(Sb Te_) ratio. The characterization of as-deposited (amorphous) films as well as crystallized (annealed) films was performed.

JTu4A.25

Electrically switchable zone plates for wavefront sensing, Luis Joel Mávita Granillo¹, Citlali Eliosa¹, Luis . Rios¹, Roger S. Cudney¹; 'CICESE, Mexico. We present theoretical and experimental results of wavefront sensing using arrays of ferroelectric Fresnel zone plates. Arrays of high quality zone plates smaller than 270 µm x 270 µm were made.

JTu4A.26

Experimental Analysis of All Optical Lens Demultiplexer for Spatial Domain Multiplexed Communication Systems, Syed H. Murshid¹, Bilas Chowdhury¹, Rayan Enaya¹, Gregory Lovell¹; ¹Florida Inst. of Technology, USA. Experimental analysis of a multi lens de-multiplexer for spatial division multiplexing is presented. Data for 635 nm as well as 1550 nm laser sources including coupled power and estimated errors is tabulated and presented.

JTu4A.27

Experimental Verification of All Optical Hollow Core Fiber Spatial Domain Demultiplexer, Syed H. Murshid', Saud Alanzi', Gregory Lovell'; 'Florida Inst. of Technology, USA. Experimental large scale testing of all optical hollow core fiber de-multiplexer for applications in spatially multiplexed communication systems. Includes power coupling analysis and compared to prior simulated results to confirm validity of the design.

JTu4A.28

Invariant Chromatic Dispersion Properties of Tellurite Hybrid Microstructured Optical Fibers With Buffer Layer, Hoang Tuan Tong', Kouki Takenaka', Harutaka Kawamura', Takenobu Suzuki', Yasutake Ohishi'; 'Toyota Technological Inst., Japan. Tellurite hybrid microstructured optical fibers with a buffer layer around the core are developed to provide invariant chromatic dispersion to the fluctuation of core diameter and maintain the broad gain bandwidth of fiber-optical parametric amplification.

JTu4A.29

Experimental Observation of Multiple Dispersive Waves and Mid-infrared Solitons in a Birefringence Tellurite Microstructured Optical Fiber, Tonglei Cheng¹, Hoang Tuan Tong¹, Xiaojie Xue¹, Dinghuan Deng¹, Takenobu Suzuki¹, Yasutake Ohishi¹; ¹ofmlab, Japan. Multiple dispersive waves emitted by multiple microstructured optical fiber are demonstrated. Obvious multiple solitons self-frequency shifts are observed in the mid-infrared region.

JTu4A.30 Withdrawn.

JTu4A.31

Spectral and Performance Analysis for the Propagation and Retrieval of Signals from Modulated Chaos Waves Transmitted through Modified von Karman Turbulence, Fathi Mohamed¹, Monish R. Chatterjee¹; 'Univ. of Dayton, USA. A transfer function formalism is applied to track propagation of modulated chaos waves through modified von Karman phase turbulence; the demodulated signal is examined vis-à-vis performance relative to turbulence strength in comparison with nonchaotic propagation.

JTu4A.32

Novel features of Anderson localization in a partially random Bragg grating, Arash Mafil²; ¹Dept. of Physics & Astronomy, Univ. of New Mexico, USA; ²Center for High Technology Materials, Univ. of New Mexico, USA. It is shown that for partially random Bragg gratings, the logarithm of the average intensity transmittance over the reciprocal wavevector space is a conserved quantity, independent of the amount of disorder.

JTu4A.33 WiO

SS-OCT Based Evaluation of Possible Impact on Vision Quality Caused by Long-Term Wear of Soft Contact Lenses., Ewa Maczynska¹, Hong Chou Lyu¹, Karol Karnowski¹, Ireneusz Grulkowski¹, Maciej Wojtkowski¹, *I*-Faculty of Physics, Astronomy and Informatics, Nicolaus Copernicus Univ., Poland. Swept-source optical coherence tomography is a new approach in metrology of contact lenses. We developed this method and used to preliminary study evaluation of possible long-term effects of contact lenses wear on vision quality.

JTu4A.34

Optical properties of Cu doped TiO₂ using First Principle calculations, Raju M Esakki Muthu¹; ¹Vidya Jyothi Inst. of Technology, India. The optical absorption spectrum and dielectric constant of Cu doped TiO₂ was studied theoretically using Time-Dependent Density-Functional Perturbation Theory to enhance the optical response of the material in visible region.

JTu4A.35

Scanning Polarimetric Scatterometer for Two-Dimensional Rough Surfaces, Juan M. López-Téllez¹, Neil C. Bruce¹, Rigoberto Nava-Sandoval¹; ¹CCADET, UNAM, Mexico. We present the mechanical design and polarization optics of a goniometric scatterometer for studying the polarized light scattering from 2D rough surfaces. The optical instrumentation includes a Mueller polarimeter based on liquidcrystal retarders.

JTu4A.36

Compensation of self-phase modulation through linear coupling in nonlinear directional fiber couplers, Nestor Lozano-Crisostomo¹, Julio C. Garcia-Melgarejo¹, Ponciano Rodriguez-Montero¹, Daniel A. May-Arrioja², Jose J. Sanchez Mondragon¹, Govind Agrawal³; ¹INAOE, Mexico; ²CIO, Mexico; ³The Inst. of Optics, Univ. of Rochester, USA. We study the effect of the linear coupling on self-phase modulation (SPM) in a nonlinear directional fiber coupler (NLDC)

when a single-input excitation is considered.

JTu4A.37

Efficient frequency doubling ultrafast Ti:Sapphire laser through the type-I NCPM of ReCOB crystals, Zhengping Wang¹, Yanqing Liu¹, Xun Sun¹, Xinguang Xu¹; 'State Key Lab of Crystal Materials and Inst. of Crystal Materials, Shandong Univ., China. Nonlinear optical (NLO) crystals ReCa₄O(BO₃)₃ (ReCOB) were found to be excellent materials for frequency doubling ultrafast Ti:Sapphire laser through type-I noncritical phase matching (NCPM) style to get 357 ~ 464 nm spectrum region.

JTu4A.38

Detection of Glomerulonephritis in the Murine Kidney by Optical Coherence Elastography, Chih Hao Liu², Young Du², Manmohan Singh², Jiasong Li², Chen Wu², Zhaolong Han², Chandra Mohan², Kirill Larin^{2,1}; ¹Molecular Physiology and Biophysics, Baylor College of Medicine, USA; ²Dept. of Biomedical Engineering, Univ. of Houston, USA. This work demonstrates the feasibility of using OCE for early detection of pathological changes in the mechanical properties of the kidney, which would complement information provided by structural images.

JTu4A.39 WiO

Masking Time-Delay Features in Multimode Vertical-Cavity Surface-Emitting Lasers, Aliza Khurram¹, Hong Lin¹; 'Bates College, USA. Polarization resolved time-delay signatures are experimentally studied for a multimode VCSEL subject to double-cavity, polarization-rotated optical feedback. Concealment of time-delay signatures is observed in certain parameter regimes.

JTu4A.40

Manipulating the photonic spin Hall effect of fan-shaped cylindrical vector beams, Peng Li¹, Yi Zhang¹, Sheng Liu¹, Jianlin Zhao¹; ¹Northwestern Polytechnical Univ., China. We develop a theoretical model to reveal the intriguing spin-dependent split for freely propagating cylindrical vector beams which modulated by fan-shaped obstacles in the perspective of angular diffraction.

JOINT FiO/LS

JTu4A • Joint FiO/LS Poster Session I-Continued

JTu4A.41

Third Harmonic Generation in Multilayer Structures: Oblique Incidence, Han Li¹, Partha P. Banerjee¹, Joseph Haus¹; 'Electro-Optics, Univ. of Dayton, USA. Under nondepleted pump assumption, third harmonic generation (THG) generated by obliquely incident fundamental frequency (FF) waves in a nonlinear multilayer structure is derived analytically by a recursive transfer matrix method (RTMM).

JTu4A.42 WiO

Extraordinary transmission-based axial imaging of live cells, Wonju Lee¹, Kyujung Kim², Jong-ryul Choi³, Youngjin Oh⁴, Donghyun Kim¹; ¹School of Electrical and Electronic Engineering, Yonsei Univ., Korea (; ²Dept. of Cognomechatronics Engineering, Pusan National Univ., Korea; ³Daegu-Gyeongbuk Medical Innovation Foundation, Korea; ⁴Samsung Electronics, Korea. We explored extraordinary transmission based axial imaging of cells. Penetration of transmitted light was controlled by varying the nanoaperture size, and axial distribution of intracellular protein was observed for different depth investigation.

JTu4A.43

Linearization of Transmission Function of Acousto-Optic Modulator, Georgy Korol¹, Dmitry Moskaletz², Oleg Moskaletz¹; ¹St Univ. of Aerospace Instrumentation, Russia; ²Electrotechnical Univ., Russia. The possibility of nonlinear transmission function transparency linearization in acousto-optic modulator (AOM) form on theoretical optics and nonlinear functional analysis methods base is described.

JTu4A.44 WiO

pH Sensing Using a Silica Toroid Microcavity, Misako Kobayashi¹, Jiro Nishimura¹, Takasumi Tanabe¹; ¹Keio Univ., USA. We realized high sensitive pH sensing of liquid by using silica toroid microcavities deposited with PAA/PAH multilayers and demonstrated the packaging of a tapered fiber and a microcavity in a liquid channel.

JTu4A.45

Temporal cavity soliton generation without laser scan in a crystalline microcavity with negative TO coefficient, Tomoya Kobatake¹, Takumi Kato¹, Hiroki Itobe¹, Takasumi Tanabe¹; ¹Keio Univesity, Japan. We numerically investigate the generation of a Kerr comb in a crystalline microcavity with negative TO coefficient such as CaF₂, where we found that a temporal soliton can be generated without a laser scan.

JTu4A.46

Metamaterial Optical Antireflection Coating, Wonkyu Kim¹, Joshua Hendrickson², Junpeng Guo¹; ¹Univ. of Alabama in Huntsville, USA; ²Wright-Patterson Air Force Base, USA. A subwavelength metal/air-gap grating metamaterial is investigated for polarization-selective optical antireflection coating. The metamaterial has designer's dielectric property for TM polarization and metallic property for TE polarization. Optical antireflection can be realized for TM polarization.

JTu4A.47

Snapshot spectro-ellipsometry based on interferometric polarization modulation, Daesuk Kim'; 'Chonbuk National Univ., Korea. This paper describes a snapshot spectro-ellipsometry based on interferometric polarization modulation. The proposed method enables us to obtain an accurate spectral Stokes vector of a thin film object in msec.

JTu4A.48

High Speed Supercontinuum Light Source Based Nanoparticle Spectral Imaging, Arpad Jakab¹, Carsten Soennichsen¹; ¹Johannes Gutenberg Uniw, Germany. We present a supercontinuum light source based high speed spectral imaging dark field microscopy setup allowing to measure over 1000 particles in less than 10 seconds with a refractive index sensitivity resolution of below 0.001.

JTu4A.49

Adaptive Optics in Two-photon Microscopy Using Coherence-gated Wave-front Sensing, Yong Hu¹; ¹Univ. of Kent, UK. By implementing a coherence-gated wave-front sensor and the adaptive optics into a two-photon microscope, the fluorescence signal exactly from the focal plane of the objective lens can be selected, and the wave-front aberration in this region can be corrected.

JTu4A.50 WiO

Manipulation of Calcite Crystals in a Beam with a Polarization Singularity, Catherine Herne¹, Alexander MacDonald¹, Ann O'Brien¹; 'SUNY New Paltz, USA. We demonstrate the rotation of birefringent calcite in a laser mode with a polarization singularity. The rotation direction of the calcite changes at different transverse coordinates depending on the circular polarization of the mode at each location.

JTu4A.51 WiO

Coupling Light in and out of Polymeric Microstructures Through Fiber Tapers, Franciele Henrique¹, Cleber R. Mendonça¹; 'São Carlos Inst. of Physics, Univ. of São Paulo, Brazil. The two-photon polymerization technique was used to produce Rhodamine B doped microstructures. To investigate their optical properties, a system of excitation and collection through fiber tapers was developed.

JTu4A.52 WiO

Holographic Gratings with Applications in Optoelectronic Systems to Transmit Multichannel Information, María del Rocío Gómez-Colín², Alejandro García-Juárez², Ignacio Zaldivar-Huerta¹, Sandra Toxqui-López², Alicia Vera Marquina², Luis Arturo García-Delgado², Ana Lilia Leal-Cruz², ¹INAOE,- Puebla, Mexico; ²Universidad de Sonora, Mexico; ³Benemérita Universidad Autónoma de Puebla, Mexico. We describe an optical and chemical procedure to obtain holographic gratings of dichromated gelatin and its integration to an optoelectronic scheme configured as multichannel system to transmit audio signals.

JTu4A.53

Sub-cycle electron dynamics in orthogonal two-color fields, JiWei Geng¹, WeiHao Xiong¹, XiangRu Xiao¹, LiangYou Peng¹, Qihuang

XiangKu Xiao', LiangYou Peng', Qihuang Gong'; 'Peking Univ., China. We theoretically investigate the sub-cycle electron dynamics in orthogonally polarized two-color laser fields by exact solution to the 3D TDSE. combined with two semi-classical methods. We find that both the nonadiabatic effects and the Coulomb potential play very important roles.

JTu4A.54

Applied kHz Optical Remote Sensing for Determination of Insect Flight Direction and Relative Size, Alem K. Gebru^{2,1}, Mikkel Brydegaard^{2,1}, Erich Rohwe¹, Pieter Neethling¹; 'Univ. of Stellenbosch, South Africa; 'Physics, Lund Univ. , Sweden. An applied kHz optical remote sensing system is implemented to determine the flight direction of an insect with respect to wind direction, and its relative size using near- and shortwave infrared light in situ.

JTu4A.55 WiO

Study on the Environmental Stability of Nickel Ion Doped Photopolymer Material for Data Storage Applications, Aswathy G¹, Sudha C. Kartha¹, Rajesh C S¹; *ICUSAT, India.* The aim of this study was to improve storage and shelf life of the photopolymer material by incorporating nickel ions into it as a cross linker. The material shows stable diffraction efficiencies for three years.

JTu4A.56

Optical Monitoring of TBI: Survey and Study of Design Parameters, Robert Francis^{1,2}, James Florence¹, Duncan MacFarlane¹; ¹Univ. of Texas at Dallas, USA; ²Raytheon, USA. Patients undergoing head trauma present intracranial maladies that may not be detected by diagnostic and monitoring instruments. This paper surveys recent TBI studies and presents optical modeling of design parameters for imaging TBI.

JTu4A.57

Real-time Optical Realization of Circle Hough Transform with Incoherent Light, Ariel Fernández¹, José Ferrari¹; 'Universidad de la Republica, Uruguay. We present an optical implementation of the circle Hough transform with an electrical lens with variable focal length and annular pupil. The system works under incoherent light and it is suitable for real-time applications. Validation experimental results are provided.

JTu4A.58

Dual-Polarity Linear Ion Trap Femtosecond Laser-Induced Ionisation/Dissociation Mass Spectroscopy for Proteomics, Taran Driver', Thomas R. Barillot', Amelle Zair', Jon P. Marangos', Leszek J. Frasinski', Marina Edelson-Averbukh'; 'Imperial College London, UK. Peptides are irradiated by femtosecond near-infrared pulses, initiating tunnel ionisation and non-ergodic molecular dissociation. Mass spectrometric analysis of the fragments gives unique structural and dynamical information for femtosecond molecular dynamics research and bioanalytical applications.

JTu4A.59 WiO

Buffer Gases Pressures Effect on Diode Pumped Rubidium Vapor Laser, Lingling Dai², Ming Ding¹, Yulong Liu¹; ¹Beihang Univ, China; ²Beihang Univ, China. We discuss the methane pressure within buffer gases effects on the performance of diode pumped rubidium vapor laser. With the methane pressure increasing from 100torr to 760torr, fluorescence efficiency decreases, optical-to-optical efficiency increases 10% approximately.

JTu4A.60

3D Video Feedback, Ross Hunter¹, Neel MacKinnon¹, Gavin MacAuley¹, Gabriel Battcock¹, Michael Forret¹, Graham Gibson¹, Johannes K. Courtial¹; ¹Univ. of Glasgow, UK. We investigate video feedback with a 3D camera and 3D TV.

JTu4A.61

Ultra-long Photonic Jet by Hemispherical Micro-particles, Zaichun Chen'; 'Singapore Univ. of Technology and Design, Singapore. Micro-particle assisted nano-imaging has proven its success in the past years. The microparticles engineered in hemispherical configuration are designed and optimized to generate an ultra-long photonic jet of 1.7 µm at 400 nm light irradiation.

JOINT FIO/LS

JTu4A • Joint FiO/LS Poster Session I—Continued

JTu4A.62

PSF Analysis of Reflective Objectives based Nonlinear 4Pi Tomography, Hao Chenglong^{1,2}, Changyuan Yu¹, Hao Li², Xia Yu², Ying Zhang²; ¹National Univ. of Singapore, Singapore; ²Singapore Inst. of Manufacturing Technology, Singapore. We proposed the nonlinear (second harmonic generation) 4Pi type C microscope using reflective objective in mid-infrared region. It provided a potential and practical solution of high resolution, deep penetration tomography in bio-medical application.

JTu4A.63

Investigation of Cross-Polarized Wave Generated at Simultaneous Spatial and Temporal Focusing, Oleg Chekhlov¹, Yunxin Tang¹, Chris J. Hooker¹, Steve Hawkes¹, Cristina Hernandez-Gomez¹, Rajeev Pattathil¹; ¹STFC Rutherford Appleton Lab, UK. Space-time focusing of spatially-chirped laser pulses is used to generate a cross-polarized wave (XPW) in a single BaF₂ crystal. We demonstrate 65 uJ output of XPW filter with improved spectral and temporal quality.

JTu4A.64

Optofluidic Ring Cavity Lasers Fabricated by 3-D Femtosecond Laser Writing Technology, Hengky Chandrahalim¹, Qiushu Chen¹, Ali A. Said², Mark Dugan², Philippe Bado², Xudong Fan¹; ¹Univ. of Michigan, USA; ²Translume Inc., USA. We fabricated a 3-D monolithically integrated optofluidic laser in a fused-silica chip using femtosecond laser pulses. Rhodamine 6G dissolved in quinoline was used as the gain medium and lasing was achieved at a pump threshold of 15 µJ/mm².

JTu4A.65

Angular spectrum solutions for the PWE: Half-integer order Bessel beams, Adrian Carbajal-Dominguez¹, Jorge Bernal¹, Gabriel Martinez-Niconoff², Ibis Ricardez-Vargas¹, Jose Segovia-Lopez¹, ¹Universidad Juárez Autonoma de Tabasco, Mexico; ²Coord. de optica, Instituto Nacional de Astrofisica, optica y electronica, Mexico. In this work we show that solutions to Paraxial wave equation in the angular spectrum of plane waves representation lead to new optical beams: half-integer order Bessel beams.

JTu4A.66

Recording dynamics and temperature impact on volume holograms in fluorite crystals with color centers, Vladimr Borisov¹, Andrey Veniaminov¹, Ekaterina Barausova¹, Alexandr Angervaks¹, Alexandr Shcheulin¹, Alexandr Ryskin¹; ¹ITMO Univ., Russia. Real-time holographic grating recording in an additively colored fluorite crystal at 180-200°C was monitored. After exposure, the diffraction efficiency was measured as a function of temperature, and significant departure of maximum diffraction

JTu4A.67

was discovered.

Implementation of Sequence Generator using Electro-Optic Effect of Mach-Zehnder Interferomete, Santosh Kumar¹, Ashish Bisht¹, Gurdeep Singh¹, Angela Amphawan²; 'Dept. of Electronics & Communication Engineering, DIT Univ., India; ²InterNetWorks Research Lab, School of Computing, Universiti Utara Malaysia, Malaysia. In this paper, a novel scheme for an optical sequence generation based on electro-optic effect of lithium niobate in Mach-Zehnder interferometer structure is presented. It can be significant for pattern generation and

encryption. JTu4A.68

Thorough Exploration of Optical Performance of Wavequides Made on Cr: LiSAF by Fem-

Control Con

JTu4A.69

Spectroscopy of the Lowest Two-Photon Transition for Molecules in Solution by Automated DFWM, Ivan Biaggio¹, Marten Beels¹; ¹Lehigh Univ., USA. We use degenerate four-wave mixing with wavelength-tunable picosecond pulses to study the second hyperpolarizability of molecules in solution. The full dispersion of both real and imaginary parts of the polarizability can be obtained using a semi-automated method.

JTu4A.70

Moiré Patterns and their Suppression during Digital Recording and Reconstruction of Fresnel Holograms, Peiyun Li¹, Yun Zhao¹, Partha P. Banerjee¹, Andy Chong¹; ¹Univ. of Dayton, USA. Moiré patterns during digital recording and reconstruction of Fresnel holograms have been analyzed for 1-D and 2-D objects. Elimination of these Moiré patterns can be achieved using pulsed, instead of CW, illumination.

JTu4A.71

Temperature-Dependent Fluorescent Dyes Application for Measuring the Millimeter Wave Absorption in Liquids Simulating Biological Tissue, Danylo Babich¹, Valentina Pobiedina¹, Yakunov Andrey¹; ¹Taras Shevchenko National Univ., Ukraine. Fluorescent organic dyes solutions are used for non-contact measurement of the microwave absorption in liquids simulating biological tissue. There was the microwaves absorption temperature equivalent measured for three liquids (water, glycerol, and ethylene glycol).



Fine Detection of Radiation Pressure on Optical Wings Using Micro Oscillators, Alexandra B. Artusio-Glimpse¹, Michelle Chabot¹, Alan D. Raisanen¹, Grover Swartzlander¹; ¹Rochester Inst. of Technology, USA. Finite element results are reported for a micromechanical oscillator used to measure the piconewton force and attonewton-meter torque imparted to a micronscale optical wing when illuminated with a 300 mW uniform laser beam.

JTu4A.73

Tamper proof? Tampering tests of optical physically unclonable functions, Benjamin R. Anderson', Ray Gunawidjaja', Hergen Eilers', 'Washington State Univ., USA. We test the tamper indicating ability of optical physically unclonable functions (O-PUFs) based on scattering nanocomposites and unique optical signatures for optimized reflection. The O-PUFs are found to be highly sensitive to tampering.

JTu4A.74

Effects of Misalignment on Diffraction of Laguerre-Gauss Vortex Beams by a Circular Aperture, Anindya Ambuj¹, Reeta Vyas¹, Surendra Singh¹; ¹Univ. of Arkansas, USA. Diffraction of Laguerre-Gauss vortex beams by a circular aperture, when the beam and aperture axes differ is studied theoretically and experimentally for different angular momentum indices and relative

displacements of beam and aperture axes.

JTu4A.75

Assessing the performances of an object recognition technique based on correlation and edge enhancement, Ayman Alfalou¹; '*ISEN-Brest, France.* A recognition technique based on correlation has been developed. To improve the correlator performances we have proposed a correction that consists in emphasizing the contour of the object based on phase contrast method.

JTu4A.76

Modal analysis of transverse Anderson localization near the boundary of a onedimensional disordered optical lattice, Behnam Abaie^{1,2}, Arash Mafi^{1,2}; ¹Dept. of Physics & Astronomy, Univ. of New Mexico, USA; ²Center for High Technology Materials, Univ. of New Mexico, USA. Using modal analysis, it is shown that Anderson localized modes near the boundaries of a disordered lattice have the same decay exponent on the lattice side as any other mode in the bulk.

JTu4A.77

Higher order dispersion effects for ultrashort pulse generation directly from a mode-locked laser with an intra-cavity highly nonlinear medium, Shinichi Inayoshi', Akiyuki Maruko', Takeshi Yoshida', Keisuke Kyomoto', Kento Kato', Hiroaki Okunishi', Kyousuke Shimabayashi', Motoki Morioka', Hiroki Kadoya', Keisuke Hayashi', Toru Sato', Shun Takashima', Sakae Kawato'; 'Univ. of Fukui, Japan. We analyzed third- and fourth-order dispersion effects on ultrashort pulse propagation in a mode-locked Yb:YAG laser with an intra-cavity highly nonlinear medium.

JTu4A.78 WiO

Z-scan for a Nonlocal Thin Media with More than One Nonlinear Response, Beatriz A. Martínez Irivas¹, Maximino L. Arroyo Carrasco¹, Marcela M. Mendez Otero¹, Ruben Ramos Garcia², Marcelo D. Iturbe Castillo²; ¹Benemérita Univ Autonoma de Puebla, Mexico; ²Optica, Instituto Nacional de Astrofisica, Optica y Electronica, Mexico. In this work we propose a model that allows to calculate the z-scan curves by a thin nonlocal media that exhibit more than one nonlinear response, both refractive and absorptive, with same or different nonlocality.

JTu4A.79

Influence of the Nonlinear Absorption in the Far-field Diffraction Patterns by a Thin Nonlocal Media, Beatriz A. Martínez Irivas¹, Maximino L. Arroyo Carrasco¹, Marcela M. Mendez Otero¹, Ruben Ramos Garcia², Marcelo D. Iturbe Castillo²; ¹Benemérita Univ Autonoma de Puebla, Mexico; ²Optica, Instituto Nacional de Astrofisica, Optica y Electronica, Mexico. Far field diffraction patterns of a thin nonlocal media that presents nonlinear absorption are analyzed numerically for different degrees of nonlocality in order to show the modifications induced by the nonlinear absorption.

JTu4A.80 WiO

Incoherent Broadband Cavity Enhanced Absorption Spectroscopy Using a Supercontinuum Source in the Mid-IR, Caroline G. Amiot^{1,2}, Antti Aalto¹, Juha Toivonen¹, Goëry Genty¹; Tampere Univ. of Technology, Finland; ²Institut FEMTO-ST, France. We developed an all-fiber based supercontinuum source spanning from 1300 to 3700 nm. We used it to perform highly sensitive gas detection using incoherent broadband cavity enhanced absorption spectroscopy.

JTu4A.81

Langmuir-Trojan Two-electron Wavepackets on Regular Polygon Orbits in Atoms and Quantum Dots, Matt Kalinski¹; ¹Utah State Univ., USA. We show that our recently discovered regular polygon orbits originated from the free fall of the electron onto the nucleus in strong magnetic field can be extended to two-electron Langmuir-like Trojan configurations in such fields.

JOINT FiO/LS

JTu4A • Joint FiO/LS Poster Session I—Continued

JTu4A.82

High-power Nd-doped fiber lasers tunable from 872 to 936nm, Baptiste Leconte¹, Benoit Cadier², Hervé Gilles¹, Sylvain Girard¹, Thierry Robin², Mathieu Laroche¹, ¹CIMAP-ENSICAEN, France; ²IXFIBER, France. High-power and tunable operation of Nd-doped fiber lasers at wavelengths as short as 872nm is reported. Using a reflective VBG, we showed a narrow linewidth (~35pm) laser emission with a maximum output power of 22W.

JTu4A.83

Frequency Analysis for 3D Localization-based Optical Microscopy, Bryce Schroeder¹, Shu Jia¹; ¹Stony Brook Univ, SUNY, USA. We conducted a comprehensive frequency-domain analysis of a recently-reported self-bending point spread function (SB-PSF) and compared it with Gaussian and astigmatic PSFs, quantifying its advantages for 3D localization-based optical microscopy. JTu4A.84 Investigation of Free Charge Carrier Effects in Silicon Membranes., Wilfrid I. Ndebeka¹, Herbert Stafast¹, Erich Rohwer¹, Christine Steenkamp¹, Pieter Neethling¹; 'Univ of Stellenbosch, South Africa. Transmission signals from silicon membranes show unexpected nonlinear effects when irradiated with a femtosecond laser at 800 nm. The nonlinear behavior of the transmitted signal is explained using free charge carrier absorption (FCA) in silicon.

JTu4A.85

cell can be revealed.

4D Two-photon Fluorescence Hyperspectral Image of Mesophyll Cells inside Intact Leaves, Poyu Su', Ting-Ying Lee', Szu-Yu Chen'; 'National Central Univ., Taiwan. The two-photon fluorescence hyperspectral microscopy based on parallel recording is applied to obtain 4D x-y-z images of mesophyll cells in intact leaves. Through principal component analysis, information of photonsystems within each mesophyll

JTu4A.86

On the Fundamental Limits of Far-Field Detection of Active Microsphere Whispering Gallery Modes, Nicolas N. Riesen¹, Tess Reynolds¹, Alexandre Francois¹, Tanya M. Monro²; ¹Inst. for Photonics and Advanced Sensing, Univ. of Adelaide, Australia; ²Univ. of South Australia, Australia. This paper investigates the Q-factor limits for far-field collection of the whispering gallery modes of active microspheres. It is shown that non-resolvable 'mode-splitting' arising from slight asphericity accounts for the typically low Q-factors.

NOTES

California	Valley	Crystal	Gold	Empire
		FiO		
16:00–18:00 FTu5A • Nonlinear Optics in Micro or Nano-Optical Structures V Presider: John Sipe; Univ. of Toronto, Canada	16:00–18:00 FTu5B • Studying Human Vision with Animal Eyes and Exploring the Limits of Human Vision Presider: Susana Marcos; Consejo Sup Investigaciones Cientificas, Spain	16:00–18:00 FTu5C • Optomechanics and Photonic Nanostructures Presider: Carrado Sciancalepore, CEA-LETI, France	16:00–18:00 FTu5D • Wavefront Sensing and Adaptive Optics Presider: Zhimin Shi; Univ. of South Florida, USA	16:00–18:00 FTu5E • Laser-matter Interaction Presider: Ian Coddington, NIST, USA
FTu5A.1 • 16:00 WiO Efficient Single Photon Emission and Col- lection Based on Excitation of Gap Surface Plasmons, Hang Lian', Ying Gu', Juanjuan Ren', Fan Zhang', Luojia Wang', Oihuang Gong'; 'Peking Univ., China. Combining ultrahigh photon emission rate of gap plasmons with efficient extraction into low-loss nanofibres, we theoretically demonstrate one-dimensional nanoscale guiding of high rate single photons of 770 γ ₀ into designed nanofibres in metallic nanorod-coupled nanofilm structures. FTu5A.2 • 16:15 Optimization of Optical Forces in Nanoscale Photonic Waveguides via Dispersion Engi- neering, Aleem M. Siddiqui', Charles Reinke', Peter T. Rakich'; 'Sandia National Labs, USA; 'Yale Univ., USA. By relating the response theory of optical forces to waveguide dispersion, we are able to employ dispersion engineering to optimize radiation pressure forces at the nanoscale in W1 photonic crystal waveguides.	FTU5B.1 • 16:00 Invited C Retinal Imaging and Cone Pointing Measure- ments in the Living Chick Eye, Nathan Doble ¹ , Maria Walker ² , Leonardo Blanco ³ , Rebecca Kivlin ⁴ , Stacey S. Choi ¹ ; ¹ Ohio State Univ., USA; ² Univ. of Houston College of Optometry, USA; ³ Ecole polytechnique, Université Paris-Saclay, France; ⁴ New England College of Optometry, USA. The chick eye is commonly used in the study of ocular growth and emmetropization. High resolution imaging results and measure- ment of the individual cone pointing in the living chick eye will be presented.	FTu5C.1 • 16:00 Invited Harnessing Photon-phonon Coupling in Integrated Optical Circuits, Raphaël Van Laer ¹ , Bart Kuyken ¹ , Alexandre Bazin ¹ , Dries Van Thourhout ¹ , Roel G. F. Baets ¹ ; 'Ghent Univ imec, Belgium. We present the state-of-the-art of stimulated Brillouin scattering in integrated optical circuits, with a particular focus on recent observations in silicon waveguides. In addition, we report on a spatiotemporal symmetry between Brillouin-active waveguides and optomechanical cavities.	Fu5D.1 • 16:00 Mitigation of Deep Turbulence Effects with SGD Based Adaptive Optics System, Ernst E Polnau', Mikhail Vorontsov', Rodolfo Llinás²; 'Univ. of Dayton, USA; 'New York Univ., USA. A low-cost AO system designed to be installed in deep turbulence conditions. The results demonstrate potentials of the technique for star-image quality improvement in amateur attronomical telescopes. FUSD.2 • 16:12 Efficient Prescription Retrieval from PSF Data, Dustin B. Moore', James R. Fienup'; 'niv. of Rochester, USA. Reverse-accumulation automated differentiation is applied to retrieve optical prescription parameters from point spread function data, yielding a 4.6x speed improvement over existing methods.	FTu5E.1 • 16:00 Invited C Laser Processing for Thin Film Solar Cell Materials, Brian J. Simonds'; 'National Inst. of Standards and Technology, USA. In this work, I will describe research of laser processing tech- niques of CdTe and Si for photovoltaic applica- tions. Processes have been developed that show improved material quality and device operation. Defect spectroscopy, device measurements, and surface science studies support these claims.
FTu5A.3 • 16:30 WiO On Chip Verification of CHSH Inequality in Mode Entangled State Using the Electro Optic Effect in Waveguide, Divya Bharadwaj', Krishna Thyagarajan', Konrad Banaszek ² ; 'Dept. of Physics, Indian Inst. of Technology, Delhi, In- dia; ² Faculty of Physics, Univ. of Warsaw, Poland. In this paper we propose a method to check for CHSH inequalities of a spatial mode entagled state using dynamic mode converters using the electro optic effect in a KTP channel waveguide.	FTu5B.2 • 16:30 Invited O Mouse Retinal Imaging with Wavefront Sen- sorless Adaptive Optics, Marinko Sarunic'; 'Simon Fraser Univ., Canada. Wavefront Sensor- less Adaptive Optics combined with Optical Coherence Tomography and fluorescence confocal Scanning Laser Ophthalmoscopy for structural and functional imaging of the mouse retina in-vivo using a MEMS deformable mirror and a novel adaptive lens.	FTu5C.2 • 16:30 WiO A Hybrid Opto-Mechanical Micro-Disk Inertia Sensor, Ghada Dushaq ¹ , Tadesse Mulugeta ¹ , Mahmoud S. Rasras ¹ ; 'Masdar Inst., United Arab Emirates. We numerically present optically enabled micro-disk inertia sensor. It consists of a disk-shaped proof mass integrated on top of an optical waveguide. It exhibits a sensitivity of 12dB/µm displacement and a dynamic range of 1g-10g.	FTu5D.3 • 16:30 Fow-Field Measurements Through Phase- Boundaries Using Wavefront Shaping, Nek- tarios Koukourakis ¹ , König Jörg ² , Büttner Lars ¹ , Carske Jürgen ¹ ; 'TU Dresden, Germany; 'IFW Dresden, Germany. We propose that aberrations introduced by single phase boundaries can be compensated by analysing the Fresnel reflex. Flow-field measurements based on image cor- relation through fluctuating and rough phase boundaries are used for validation.	FTu5E.2 • 16:30 Invited C Engineering Anisotropy in Glass with Ultrafast Laser Assisted Nanostructuring, Martynas Beresna', Rokas Drevinskas', Jingyu Zhang', Mindaugas Gecevicius', Peter Kazansky'; 'Univ. of Southampton, UK. Recent applications of femtosecond laser assisted self-assembled nanostructures will be overviewed. Specifically, polarization sensitive optical elements and 5-di- mensional optical data storage with practically unlimited life-time will be demonstrated and discussed.

FiO

16:00-18:00

Sydney, Australia

in 3D tissue culture.

FTu5E.1 • 16:00 Invited

Sacramento

FTu5F • Optical Trapping and Manipulation

Optical Characterization of Pericellular Mechanical Hetero-

geneity, Mark Keating¹, Abhishek Kurup¹, Elliot Botvinick¹;

¹UC Irvine Beckman Laser Inst., USA. While there is strong

evidence for roles of bulk tissue stiffness in cell regulation,

roles for the pericellular mechanical microenvironment are

less clear. We use optical microrheology to study these roles

Presider: Alvaro Casas-Bedoya; Univ. of

Hillsborough

LTu5G • Precision Laser Spectroscopy II

Presider: R. Jason Jones; Univ. of Arizona,

Two-photon Frequency Comb Spectroscopy of Atomic

Hydrogen with Chirped Laser Pulses, Arthur Matveev1,

Dylan C. Yost², Alexey Grinin¹, Theodor W. Hänsch¹, Thomas

Udem¹; ¹Max-Planck-Institut fur Quantenoptik, Germany;

²Univ. of Colorado, USA. We report on the results of two-

photon spectroscopy of 1S-3S transition in atomic hydrogen

using picosecond mode-locked laser. The chirp of the laser

pulses leads to frequency shift proportional to the velocity

16:00-18:00

LTu5G.1 • 16:00 Invited

USA

of the atoms.

Piedmont

LS

16:00-18:00 LTu5H • Novel Fiber Lasers III Presider: Tarig Manzur; NAVSEA Naval

Undersea Warfare Ctr, USA

LTu5H.1 • 16:00

Narrow Linewidth CW Fiber Raman Amplifiers Based on SBS Suppressed Gain Fibers, James Nagel¹, Valery Temyanko¹, Nasser Peyghambarian¹, Jeremy Dobler², Evgeny M. Dianov³, Mikhael Likhachev³, M bubnov³, M Salganskii⁴, A Guryanov⁴, D Lipatov⁴; ¹Univ of Arizona, Coll of Opt Sciences, USA; ²Harris Corporation, USA; ³Fiber Optic Research Center, Russia; ⁴Inst. of High Purity Substances, Russian Academy of Sciences, Russia. We report on advancements in silicatebased Raman gain fibers for improving power and efficiency performance of narrow linewidth amplifiers. SBS suppression

manosilicate fibers and Raman amplification.

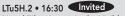
Tuesday, 20 October

FTu5F.2 • 16:30 Invited

New Directions in Optical Manipulation, Kishan . Dholakia1; ¹Univ. of St Andrews, UK. This talk describes combining beam shaping with the material properties of particles for enhanced manipulation. Additional work using new fibre optic approaches as well as combining trapping and imaging will be described.

LTu5G.2 • 16:30 Invited

Laser Spectroscopy of Muonic Atoms and Ions, Randolf Pohl¹; ¹Max-Planck-Institut fur Quantenoptik, Germany. Laser spectroscopy of muonic atoms, where a nucleus is orbited by one negative muon, is a novel tool for tests of quantum electrodynamics and the Standard Model, determination of fundamental physical constants, and for nuclear physics.



Novel Fiber Lasers in the Visible, SWIR, and MWIR, Jason M. Auxier¹; ¹US Naval Research Lab, USA. This presentation will provide an overview of novel fiber laser sources in the visible, short-wave infrared (SWIR), and mid-wave infrared (MWIR). Additionally, recent work in the long-wave infrared (LWIR) will be presented.

California	Valley	Crystal	Gold	Empire
		FiO		
FTu5A • Nonlinear Optics in Micro or Nano-Optical Structures V— Continued	FTu5B • Studying Human Vision with Animal Eyes and Exploring the Limits of Human Vision— Continued	FTu5C • Optomechanics and Photonic Nanostructures— Continued	FTu5D • Wavefront Sensing and Adaptive Optics—Continued	FTu5E • Laser-matter Interaction—Continued
FTu5A.4 • 16:45 Ultra Broadband Entanglement Analysis for High-Speed Quantum Key Distribution in Dense Wavelength Division Multiplexed Networks, Florian Kaiser', Djeylan Aktas', Lau- rent Labonté', Sébastien Tanzilli'; 'Laboratoire de Physique de la Matière Condensée, CNRS UMR 7336, Université Nice Sophia Antipolis, France. Using broadband entangled photons at a telecom wavelength we measure dispersion in our fiber interferometers and counteract it by properly unbalancing the interferometers. Our scheme allows to increase bit rates in wavelength demultiplexed networks.		FTu5C.3 • 16:45 Optomechanical Crystals Fabricated by a CMOS Foundry, Rodrigo Benevides', Gustavo O. Luiz', Felipe G. Santos', Gustavo S. Wieder- hecker', Thiago Alegre'; 'Universidade Estadual de Campinas, Brazil. Photonics crystal optome- chanical cavities fabricated on a commercial CMOS-compatible foundry are demonstrated. Despite the limited foundry design rules we could achieve a ultra-high Q (9.1×10 ^s) photonic crystals and optomechanical crystal cavities with large coupling rate (g_0 =60 KHz).	FTu5D.4 • 16:45 Wavefront Sensing via Attenuated Reflec- tion using Near-Resonant Surface-Plasmon Polariton Excitation, Brian Vohnsen ¹ , Denise Valente ¹ ; 'Univ. College Dublin , Ireland. Inten- sity variations are commonly used in curvature sensing of aberrations. Here, we demonstrate that attenuated reflection in near-resonant excitation of surface-plasmon polaritons can be used to determine gradients from which the wavefront may be reconstructed.	
FTu5A.5 • 17:00 Ultra-Fast All-Optical Modulator Using Nano-Waveguide Embedded in High Pressure Buffer Gas, Mohamed Fouda', Selim Shahriar'; 'Northwestern Univ., USA. We propose imple- mentation of an ultra-fast, low power all-optical modulator at telecommunication wavelength via interaction of evanescent light field around a silicon nitride nano waveguide with Rubidium vapor under high pressure buffer gas.	FTu5B.3 • 17:00 Invited Two-photon Autofluorescence Imaging of Retinal Structure and Function in the Liv- ing Primate Eye, Robin Sharma ^{6,2} , Christina Schwarz ² , David R. Williams ^{1,2} , Grazyna Pal- czewska ⁴ , Krzysztof Palczewski ^{5,6} , Jennifer J. Hunter ^{2,2} ; 'The Inst. of Optics, USA; ² Center for Visual Science, Univ. of Rochester, USA; ³ Flaum Eye Inst., Univ. of Rochester, USA; ⁴ Pol- genix, Inc, USA; ⁵ Dept. of Pharmacology, Case Western Reserve Univ., USA; ⁴ Cleveland Center	FTu5C.4 • 17:00 Invited Control of Coherent Information by Mixing Light and Sound in Photonic Circuits, Peter T. Rakich', Heedeuk Shin', Cox Jonathan ² , Robert Jarecki ² , Zheng Wang ³ ; ¹ Yale Univ., USA; ² Sandia National Labs, USA; ³ Electrical Engineering and Computer Science, Univ. of Texas at Austin, USA. Through a new class hybrid-photonic phononic waveguide structures we show that artificial Brillouin nonlinearities can be created and manipulated in silicon. Exploiting the nonlocal	FTu5D.5 • 17:00 WiO New Arrangements for Waveguide-Based Wavefront Sensors, Denise V. dos Santos ² , Di- ego Rativa ¹ , Brian Vohnsen ² ; 'Polytechnic School of Pernambuco, Univ. of Pernambuco, Brazil; ² Advanced Optical Imaging Group, School of Physics, Univ. College Dublin, Ireland. An array of parallel thin rectangular waveguides and a combination of rectangular and circular wave- guides are proposed for wavefront sensing. The advantages and limitations of each are analyzed.	FTu5E.3 • 17:00 The Influence of an Electric Field on Revers- ible Photodegradation of a Dye-Doped Poly- mer, Benjamin R. Anderson ² , Mark G. Kuzyk ¹ ; ¹ Physics, Washington State Univ., USA; ² Applied Sciences Lab, Washington State Univ., USA. We generalize the statistical mechanical domain model of self healing dye-doped polymers to include the effects of an electric field and find that it predicts all observations including the effect of an applied electric field.
FTu5A.6 • 17:15 WiO Quantum Statistics Control with Multimode Plasmonic Nanocavity: Cavity-Openness- Induced Interferences, Dongxing Zhao ¹ , Ying Gu ^{1,2} , Hongyi Chen ¹ , Juanjuan Ren ¹ , Tiancai Zhang ³ , Qihuang Gong ^{1,2} ; ¹ State Key Lab for Mesoscopic Physics, Dept. of Physics, Peking Univ., China; ² Collaborative Innovation Center of Quantum Matter, China; ³ State Key Lab of Quantum Optics and Quantum Optics Devices, Inst. of Opto-Electronics, Shanxi Univ., China. Using scattered field interference introduced by the high cavity openness, both bunched and antibunched fields can be obtained from a quantum emitter-plasmonic multimode nano- cavity hybrid system.	for Membrane and Structural Biology, Case Western Reserve Univ., USA. The retina contains endogenous fluorophores (eg. NADH, retinoids and others) that are natural markers for physiol- ogy and morphology. Adaptive optics assisted two-photon excitation was employed to record fluorescence from these molecules throughout the retina in living macaques.	nature of photon-phonon couplnig, we realize emit-receive functionalities to achieve coherent control of information.	FTu5D.6 • 17:15 Compressive sensing with quadratic phase systems based cryptography, Inbarasan Muniraj', Changliang Guo', John T. Sheridan'; 'Univ. College Dublin , Ireland. We examine the sparse-sensing mechanism of compressive sensing (CS) systems with the linear canonical transform based DRPE system. Encrypted data is randomly sampled using CS theory. Experi- mental results demonstrate the feasibility of the proposed technique.	FTu5E.4 • 17:15 E WiO Direct Laser Writing of Fluorescent Silver Nanoclusters in Polyvinyl Alcohol Films, Na- zanin Karimi', Puskal Kunwar', Juha Toivonen'i, 'Tampereen Teknillinen Yliopisto, Finland. We demonstrate successful fabrication of fluores- cent microstructures by direct laser writing of silver nanoclusters in polyvinyl alcohol films using a cost-effective laser diode. The nano- clusters show very good photostability in the widely used polymer material.

Glen Ellen	Sacramento	Hillsborough	Piedmont
F	iO	L	S
Reminder:	FTu5F • Optical Trapping and Manipulation—Continued	LTu5G • Precision Laser Spectroscopy II— Continued	LTu5H • Novel Fiber Lasers III—Continued
FiO/LS 2015 Program now available in mobile formats! Visit www.frontiersinoptics.com for more information.	FTu5F.3 • 17:00 Witrabroadband plasmonic super absorbers for mul- tiplexed surface enhanced Raman spectroscopy, Nan Dhang', Kai Liu', Haomin Song', Xie Zeng', Dengxin Ji', Giaoqiang Gan'; 'State Univ. of New York at Buffalo, USA. We developed an ultra-broadband super-absorbing metasur- ace substrate for SERS sensing. In contrast to conventional substrates working for limited excitation wavelengths, this structure can work for almost "all" laser lines from 450-nm to 1000-nm. FTu5F.4 • 17:15 DOO Dytofluidic manipulation of microsphere by graded-index fiber with flat endface. Chenlin Zhang', Yuan Gong', Qun Liu', Yu Wu', Yunjiang Rao'; 'UESTC, China. Optofluidic manipulation of microsphere is achieved by a graded-index fiber (GIF) with a flat endface. The manipulation length is controlled by strain on GIF and can be tuned up to 1000 µm.	LTu5G.3 • 17:00 Invited Probing Buffer-Gas Cooled Molecules with Direct Fre- quency Comb Spectroscopy in the Mid-Infrared, Benjamin Spaun', Bryan Changala', Bryce Bjork', Oliver Heckl', David Patterson', John Doyle', Jun Ye'; 'Univ. of Colorado at Boul- der JILA, USA; 'Physics, Harvard Univ., USA. We demonstrate cavity-enhanced direct frequency comb spectroscopy on buffer-gas cooled molecules. By coupling a mid-infrared frequency comb to a high-finesse cavity surrounding a 4 K buffer-gas chamber, we obtain rotationally resolved absorp- tion spectra of multiple vibrational bands of nitromethane.	LTJSH.3 • 17:00 United Compact Ultrafast Fiber Lasers for Nonlinear Optical Mi- roscopy, Khanh Q. Kieu'; 'Univ. of Arizona, USA. We discuss the development of compact, affordable femtosecond fiber lasers for nonlinear optical microscopy. Application in brain imaging and Barrett's cancer imaging will be presented.

California	Valley	Crystal	Gold	Empire
		FiO		
FTu5A • Nonlinear Optics in Micro or Nano-Optical Structures V— Continued	FTu5B • Studying Human Vision with Animal Eyes and Exploring the Limits of Human Vision— Continued	FTu5C • Optomechanics and Photonic Nanostructures— Continued	FTu5D • Wavefront Sensing and Adaptive Optics—Continued	FTu5E • Laser-matter Interaction—Continued
FTu5A.7 • 17:30 Theory of Feedback Cooling of an Opti- cally Trapped Nanoparticle into the Quantum Ground State, Brandon V. Rodenburg ^{1,2} , Levi Neukirch ^{3,2} , Monica Rizzo ¹ , Nick Vamivakas ^{4,2} , Mishkat Bhattacharya ^{1,2} ; 1Physics and Astrono- my, Rochester Inst. of Technology, USA; ² Center for Coherence and Quantum Optics, USA; ³ Physics and Astronomy, Univ. of Rochester, USA; ⁴ Inst. of Optics, Univ. of Rochester, USA; ⁴ Inst. of Optics, Univ. of Rochester, Development of a quantum master equation describing an optically trapped and cooled nanoparticle is presented. Using this model, we describe how the center of mass motion can be cooled to the quantum ground state.	FTu5B.4 • 17:30 WiO Polarization Imaging in the Retina of a Dog Model of Alzheimer's Disease Enables Dis- crimination of Amyloid Deposits, Melanie C. Campbell ¹ , David Devries ¹ , Theodore Chow ¹ , Laura Emptage ¹ , Namrata Shah ¹ , Howard Dob- son ^{2,3} , Christopher Cookson ¹ , Marsha Kisilak ¹ ; ¹ Univ. of Waterloo, Canada; ² inviCRO, USA; ³ Univ. of Guelph, Canada. Beagle dogs suffer from a naturally occurring cognitive dysfunction syndrome, with symptoms and brain pathology similar to Alzheimer's disease. We show that polarization imaging correctly classifies 95% of amyloid deposits from surrounding retina in diseased dogs.	FTu5C.5 • 17:30 D Molecular Optomechanics with Plasmons: Backaction at the nanoscale, Philippe Roelli ¹ , Christophe Galland ¹ , Nicolas Piro ¹ , Tobias J. Kippenberg ¹ ; 'Ecole Polytechnique Federale de Lausanne, Switzerland. The plasmonic systems used in surface-enhanced Raman scattering are shown to be quivalent to optomechanical cavi- ties. The new backaction force of the plasmon on the molecular vibration could lead to coher- ent amplification of vibrational motion.	FTu5D.7 • 17:30 Stability of unique optical signatures un- der translation and rotation, Benjamin R. Anderson', Ray Gunawidjaja', Hergen Eilers'; 'Washington State Univ., USA. We measure the stability of unique spatial light modulator (SLM) based optical signatures under sample translation and rotation. The signature's stability is found to depend on sample type, beam size, and SLM bin size.	FTu5E.5 • 17:30 Disportance of Hydrogen Bonding in Thermal Lens Study of Highly Absorbing Liquids, Sumit Singhal', Partha P. Roy', Debabrata Goswami', 'Dept. of Chemistry, Indian Inst. of Technol- ogy Kanpur, India. Effect of thermal load on highly absorbing hydrogen bonded liquids are explored. We find heat transfer is better facilitated in lesser hydrogen bonded liquids by convection through molecular motion in addition to conduction.
FTu5A.8 • 17:45 Raman Cooling of Solids through Density of States Engineering, Yin-Chung Chen ¹ , Gaurav Bahl'; 'Univ. of Illinois Urbana-Champaign, USA. We show that engineering the 3D optical density of states of highly transparent solids can permit enhancement of anti-Stokes Raman scattering over Stokes scattering. When implemented through a diamond-structure photonic crystal in silicon, laser cooling using pure Raman scat- tering can be achieved.	FTu5B.5 • 17:45 D WIO Testing the Limits of Human Vision with Single Photons, Rebecca Holmes ¹ , Bradley G. Christensen ¹ , Ranxiao F. Wang ² , Paul G. Kwiat ¹ ; ¹ Physics, Univ. of Illinois at Urbana-Champaign, USA; ² Psychology, Univ. of Illinois at Urbana- Champaign, USA. We discuss techniques using a heralded single-photon source to study the lower limit of human vision, and report some preliminary results, including a measurement of temporal integration at the few-photon level.	FTu5C.6 • 17:45 Efficient electro-optic modulation of a weakly localized resonance in a photonic crystal waveguide, Yuta Ooka', Nurul Ashikin B. Daud', Tomohiro Tetsumoto', Takasumi Tanabe'; 'Tanabe photonic structure group, Japan. We demonstrate ultrahigh Q and electro-optic modulation of weakly localized photonic crystal resonance in a fluctuated waveguide, where the position of the mode is controlled by reducing the width of the waveguide locally.	FTu5D.8 • 17:45 Designing Water Content Sensor of Several Kinds of Fuel Using Fiber Optic Coated with Gelatin as the Cladding, Alvien K. Sosilo ¹ , Ahmad N. Fauzy ¹ , Niki Etruly ¹ ; 'Engineering Physics, Institut Teknologi Sepuluh Nopember, Indonesia. Gelatin can change its refraction index when submerged into a liquid and it effects on output power of the fiber optic. By measuring the output power, we could know the water content of several liquids.	FTU5E.6 • 17:45 O Annular Space-Time Focusing in Fused Silica, Thomas Lanier', Jeremy R. Gulley', 'Kennesaw State Univ., USA. We describe simulations of nonlinear space-time focusing of femtosecond annular beams in silica. Adjusting the chirp of µJ pulses traversing a pair of concentric gratings leads to pronounced plasma blue-shift, and enhanced material modification localization.
	16:00–17:00 Exhibitor App	reciation Reception (exhibitors only),	Exhibit Hall, Imperial Ballroom	
	16:00–17:00 Minorities	and Women in OSA (MWOSA) Netwo	rking Reception, Atherton	

17:00–17:45 OSA Annual Business Meeting, Fairfield

17:00–18:00 APS Division of Laser Science Annual Business Meeting, Belvedere

18:30–20:30 OSA Member Reception, Grande Ballroom, The Westin San Jose, 302 S. Market St., San Jose, CA

19:00–22:00 Laser Science Banquet, Gordon Biersch, 33 East San Fernando St, San Jose, CA

Sacramento

Optical Advection, Veerachart Kajorndejnukul¹, Sergey

Sukhov¹, Aristide Dogariu¹; ¹Univ. of Central Florida, CREOL,

USA. We demonstrate that under the external driving of a

small bias optical force, the long range hydrodynamic interac-

tion between colloidal particles can be harnessed to enhance

FTu5F • Optical Trapping and

the collective and directional transport.

Manipulation—Continued

Hillsborough

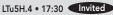
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LTu5G • Precision Laser Spectroscopy II— Continued LTu5H • Novel Fiber Lasers III—Continued

LTu5G.4 • 17:30 Invited WiO

Molecular Spectroscopy with Two Laser Frequency Combs: From Vibrational to Doppler-Free Resolution, Nathalie Picque^{1,2}; ¹Max-Planck-Institut fur Quantenoptik, Germany; ²Fakultät für Physik, Ludwig-Maximilians-Universität München, Germany. Dual-comb systems become enabling tools for applications involving interferometry. Illustrations will be given in the field of broadband molecular spectroscopy, where linear and nonlinear effects are harnessed.



Ultrafast Lasers Enabled by Graphene and Other 2D Materials, Zhipei Sun'; 'Dept. of Micro- and Nanosciences, Aalto Univ., Finland. I will review the current state-of-theart of ultrafast lasers mode-locked by graphene and other two-dimensional layered materials (including molybdenum disulfide, and black phosphorus).

FTu5F.6 • 17:45

FTu5F.5 • 17:30

FiO

Mechanical Action of Optical Spin-Orbit Interaction, Sergey Sukhov¹, Veerachart Kajorndejnukul¹, Roxana Rezvani Naraghi^{1,2}, Aristide Dogariu¹; ¹Univ. of Central Florida, *CREOL, USA*; ²Dept. of Physics, Univ. of Central Florida, USA. The transformation of spin angular momentum into an orbital one breaks the mirror symmetry of scattering. An adjacent interface further distorts the central symmetry and induces an anomalous lateral force on the scattering object.

16:00–17:00 Exhibitor Appreciation Reception (exhibitors only), Exhibit Hall, Imperial Ballroom

16:00–17:00 Minorities and Women in OSA (MWOSA) Networking Reception, Atherton

17:00–17:45 OSA Annual Business Meeting, Fairfield

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18:30–20:30 OSA Member Reception, Grande Ballroom, The Westin San Jose, 302 S. Market St., San Jose, CA

19:00-22:00 Laser Science Banquet, Gordon Biersch, 33 East San Fernando St, San Jose, CA

07:00–18:00 Registration, Market Street Foyer

08:00–09:30 JW1A • Joint FiO/LS Plenary and Awards Session II, Regency Ballroom

09:00–16:00 CAM Lounge, Market Street Foyer

09:30–14:00 Exhibit Hall Open, Exhibit Hall, Imperial Ballroom

09:30–11:00 Coffee Break (09:30-10:00) and Unopposed Exhibit Only Time, Exhibit Hall, Imperial Ballroom

10:00–12:00 OSA Friends and Family Tour of Rosicrucian Egyptian Museum and Planetarium (Bus departs from Fairmont San Jose's main entrace at 10:15)

Exhibit Hall, Imperial Ballroom

JOINT FIO/LS

09:30-11:00 JW2A • Joint FiO/LS Poster Session II

JW2A.5

JW2A.7

Design and Implementation of a Fiber Optic Corrosion Sensor based on Macrobend Losses using OTDR, Shailendra K. Varshney¹, Gagan S. Dhingra¹; ¹Indian Inst. of Technology Kharagpur, India. We report fabrication and proof-ofconcept of a simple corrosion sensor utilizing the intensity modulation due to macrobending losses. The sensor head consists of SMF bent into particular radius, held by "corrosion fuses"

JW2A.8

of different thicknesses.

Metasurface Circular Polarization Splitter, Wei-Yi Tsai¹; ¹Dept. of physics, NTU, Taiwan. Here, we present a meta-device which can resolve the handed of circular polarization and wavelength of incident light through diffraction angles.

JW2A.9

Superluminality Effect due to Femtosecond Laser Pulse Self-Trapping by the Nanorods Melting Front, Vyacheslav Trofimov¹, Tatiana Lysak¹; ¹Lomonosov Moscow State Univ., Russia. We show a possibility for superluminality effect at a femtosecond pulse propagation in a medium with gold nanorods under the nanorods melting and a positive phase-amplitude grating, induced by laser radiation.

JW2A.10

Moving Soliton and Localized Soliton at PC Boundary, Vyacheslav Trofimov¹, Tatiana Lysak¹; ¹Lomonosov Moscow State Univ., Russia. We demonstrate two new types of solitons in a nonlinear PC: the moving soliton, which moves across the PC layers and many times reflects from the PC boundaries, and the oscillating surface soliton that is localized near the PC boundary.

JW2A.11

Chracterization and fabrication of silica-gold composite toroidal optical microcavity, Sho Tamaki¹, Wataru Yoshiki¹, Takasumi Tanabe¹; ¹Keio Univ., Japan. We fabricate silica-gold composite toroidal microcavity and investigate the nonlinear property both theoretically and experimentally. An efficient thermo-optic

switching is demonstrated due to the enhanced absorption coefficient of the material.

JW2A.1

JW2A.2 WIO

Graphene plasmonics for light trapping and

absorption engineering in optoelectronic de-

vices, Jianfa Zhang¹, Wei Xu¹, Zhihong Zhu¹, Wei

Liu¹, Xiaodong Yuan¹, Shigiao Qin¹; ¹National

Univ. of Defense Technology, China. We investi-

gate the usage of graphene plasmonics for light

trapping in optoelectronic devices which can

enhance the absorption in surrounding materials

by tens of times along with electrical tunability.

High Sensitivity Hybrid Plasmonic Rectangu-

lar Resonator for Gas Sensing Applications,

Aya Zaki^{1,2}, Khaled Kirah¹, Mohamed Swillam²;

Faculty of Engineering, Ain Shams Univ., Egypt;

²School of Science and Engineering, American

Univ. in Cairo, Egypt. A compact plasmonic

rectangular sensor of effective fabrication cost

is proposed. A hybrid coupling mechanism is uti-

lized. The structure is optimized using numerical

simulations. A high sensitivity of 1385 nm/RIU is

reached at wavelength of 1.55 µm.

JW2A.3

Chip-integrated nearly perfect graphene

absorber, Wei Xu1, Zhihong Zhu1, Ken Liu1, Jianfa Zhang¹, Xiaodong Yuan¹, Qisheng Lu¹, Shigiao Qin1; 1National Univ. of Defense Technolog, USA. We exploit the concept of critical coupling to graphene based chip-integrated applications and numerically demonstrate that chip-integrated nearly perfect absorber at near-infrared can be obtained by graphene nearly critical coupling with a nanobeam cavity.

JW2A.4

Second Quantization of Gaussian Modes and Mode Interaction in Limited Space, Zhihao Xiao¹, R. Nicholas Lanning¹, Mi Zhang², Irina Novikova², Eugeniy E. Mikhailov², Jonathan P. Dowling¹; ¹Dept. of Physics & Astronomy, Louisiana State Univ., USA; ²Dept. of Physics, College of William & Mary, USA. We second quantize multiple orders of Gaussian modes. We analytically examine the interaction between modes when space is limited and the orthogonality between modes is destroyed. We numerically simulate the effect of interaction on squeezed vacuum states and show it matches experimental data.

Influence of a Weak Continuous Wave Trigger on Continuous Wave Pumped Supercontinuum Generation, Cai Wen¹, Hui Huang¹, Zihao Cheng¹, Qian Li¹; ¹Peking Univ. Shenzhen Graduate School, China. We demonstrate a simple continuous wave trigger scheme that can greatly enhance the stability of the continuous wave pumped supercontinuum generation.

JW2A.6

Hydrogel Coated Fiber Bragg Grating Based pH Sensor, Pabbisetti Vayu Nandana Kishore¹, Sai Shankar Madhuvarasu¹; ¹Physics, National Inst. of Technology, India. Fiber Bragg grating based pH sensor is proposed. A pH responsive hydrogel which swells in presence of pH media is utilized for the study. The sensor head is subjected to different pH solutions ranging from pH 1 to pH 7. A linear increase of wavelength shift is observed.

JOINT FIO/LS

JW2A • Joint FiO/LS Poster Session II—Continued

JW2A.12

Anatomy of Phase Locking in Parametric Frequency Combs, Hossein Taheri', Ali A. Eftekhar', Kurt Wiesenfeld', Ali Adibi'; 'Georgia Inst. of Technology, USA. We investigate the dynamical origin of phase locking of optical frequency combs in Kerr-nonlinear media using few-mode approximations of the Lugiato-Lefever equation. We find analytical expressions which reveal the essence of phase locking.

JW2A.13 WiO

Analysis of electric field distribution in SPR refractive index sensor using different conducting metal oxides, Rana Tabassum'; ¹Indian Inst. of Technology, Delhi, India. We report comparative study of electric field distribution inside the probe coated with Ag and conducting metal oxides. For refractive index sensing, field inside TiO₂, SiO₂, SnO₂ and ZnO has been studied.

JW2A.14

Secret Key Rates of QKD Systems Over Time-Varying Free-Space Optical Channel, Xiaole Sun', Ivan Djordjevic', Mark Neifeld'; 'Univ. of Arizona, USA. We study SKRs of QKD systems over time-varying FSO channels under strong turbulence. A channel predictive method is proposed to improve corresponding SKRs. The results show that the higher SKR can be obtained for better prediction accuracy.

JW2A.15

Theoretical Study of the Effect of Quantum Noise on the Nonlinear Dynamics of a Semiconductor Laser Subject to Two Filter Optical Feedbacks, Joseph Suelzer¹, Rupamanjari ¹Indiana Univ.-Purdue Univ. Indianapolis, USA; ²Shiv Nadar Univ., India; ³Univ. of Delhi, India. We demonstrate that the role of quantum noise in a semiconductor laser subject to two filtered feedbacks is to stabilize the laser dynamics such that stronger feedback levels are necessary for onset of chaos.

JW2A.16

Realization of Parity-Time-Symmetry Breaking in Delay Coupled Semiconductor Lasers, Joseph Suelzer¹, Yogesh Joglekar¹, Gautam Vemuri¹; ¹Indiana Univ.-Purdue Univ. Indianapolis,

Joseph Suelzer', Yogesh Joglekar', Gautam Vemuri'; 'Indiana Univ.-Purdue Univ. Indianapolis, USA. We present an experimental realization of PT-symmetry breaking in time-delay coupled semiconductor lasers and investigate the properties of the PT-threshold. A theoretical model is developed to explain the observations and agrees well with the data.

JW2A.17

Effect of a sinusoidal type modulation in the refraction index of a 1D photonic crystal, Daniel G. Suerez Forero¹, Alvaro Montaña Guerrero¹, Herbert Vinck Posada¹; 'Universidad Nacional de Colombia, Colombia. The effects of a periodic modulation on the refractive index of the intercavity zone of a 1D photonic crystal with two cavities are studied. It is found that this mechanism allows to manipulate the coupling between cavities.

JW2A.18

Optical Bistability with Two Serially Integrated InP-SOAs on a Single Chip, Michael Plascak¹, Jukka Viheriälä², Mircea Guina², Azad Siahmakoun¹; Rose-Hulman Inst. of Technology, USA; ²Optoelectronics Research Centre, Tampere Univ. of Technology, Finland. Optical bistability has been achieved with two serially integrated MQW-InP SOAs in reverse-bias on a single

chip. We demonstrate that switching speed in

GHz range is possible and discuss performance

limitations of the bistable device.

JW2A.19

Molecularly Imprinted Fiber Optic SPR Sensor for Parathion Methyl Detection, Anand M. Shrivastav¹, Banshi D. Gupta'; ¹Indian Inst. of Technology, Delhi, India. Fabrication and characterization of surface plasmon resonance based fiber optic sensor for parathion methyl detection using molecular imprinting have been reported. The operating range of the sensor is 10⁻¹³M to 10⁻⁸M.

JW2A.20

Angular Distribution of the Emission of a 2-D Optofluidic Random Laser, Anirban Sarkar¹, Shivakiran Bhaktha B. N.¹; ¹Indian Inst. of Technology Kharagpur, India. We observe the regular diffraction pattern and angularly resolved random lasing spikes within a single diffraction line from a 2-D structured optofluidic random laser due to the randomness in the size distribution of the scatterers.

JW2A.21

Integrated Microring Resonator as a Perfect Absorber, Enrique Sanchez Cristobal', Jose J. Sanchez Mondragon¹, Mercedeh Khajavikhan²; ¹Inst Nat Astrofisica Optica Electronica, Mexico; ²CREOL, College of Optics and Photonics, Univ. of Central Florida, USA. Coherent perfect absorption is demonstrated in an integrated microring resonator laterally coupled to two optical waveguides. Two counterpropagating waves of equal phase and intensity are launched into the microring resonator and eventually they get absorbed.

d JW2A.22

Fiber Optic Gyroscope Based on the Registration of the Spatial Interference Pattern, Andrii Sakhno¹, Stanislav Tuzhanskyi¹; ¹Vinnytsia National Technical Univ., Ukraine. Design of a fiber optic gyroscope (FOG) using a photosensitive line to scan interferograms is proposed. The suggested FOG design significantly reduces the impact of the following optical noise factors: zero drift, Rayleigh scattering, etc.

JW2A.23 WiO

Vibrational Spectroscopic (FTIR and FT-RAMAN) Studies, HOMO LUMO Analysis, NMR Chemical Shifts and Electrostatic **Potential Surface of 2,3-DIBROMOFURAN**, Sruti S¹, Rasheed M.P.²; ¹ECE, St.Joseph's College of Engineering, India; ²Physics, UD College, India. The FTIR and FT Raman spectra of 2,3-dibromofuran have been recorded in the region 4000-400 cm-1 and 4000-100 cm-1 respectively. The optimized frequency, the observed geometry and intensity of vibrational bands of the sample were obtained using DFT using 6-311++G(d,p) basis set.

JW2A.24

Frequency Conversion of Short Optical Pulses in Negatively Spatially Dispersive Metamaterials, Alexander K. Popov¹, Sergey A. Myslivets^{2,3}; 'Birck Nanotechnology Center, Purdue Univ., USA; ²L.V. Kirensky Inst. of Physics SB RAS, Russia; ³Siberian Federal Univ., Russia. We show that particular spatial distributions of nanoscopic plasmonic building blocks in metamaterials may enable extraordinary nonlinear-ootical

frequency-shifted reflectivity and pulse shaping.

JW2A.25

Diagrammatic Representation of Multimode Raman Scattering with Stokes and Anti-Stokes Sidebands, Michal Parniak¹, Daniel Pecak², Wojciech Wasilewsk¹; ¹Univ. of Warsaw, Poland; ²Inst. of Physics, Polish Academy of Sciences,

Poland. We analyze the Raman interaction of Stokes and anti-Stokes sidebands with atomic coherence. The interaction is decomposed into a set of three-mode quantum operations. We represent these operations as two-mode squeezing and beamsplitters.

JW2A.26

Effect of Hole Transport Organic Layer on Characteristics of Hybrid Photovoltaic Structure, Antonio Olivares Vargas'; 'Inst Nat Astrofisica Optica Electronica, Mexico. Here we report on the effect of PEDOT:PSS based p-type organic layer on characteristics of hybrid solar cells in p-i-n configuration. We demonstrated that isopropanol treatment of the PEDOT:PSS is effective for improving the performance characteristics of the device.

JW2A.27

Singular Phonons in a Helically Confined Degenerate Quantum Gas., Alex Okulov¹; ¹Russian Academy of Sciences, Russia. The elementary excitations in ultracold quantum gas within helical optical potential produced by vortices with high angular momenta are considered via linearized Gross-Pitaevskii equation. The dispersion law is obtained.

JW2A.28

Tellurite Microstructured Optical Fiber Based Raman Soliton and Dispersive Wave Generation, Lei Zhang', Hoang Tuan Tong', Weiqing Gao', Harutaka Kawamura', Takenobu Suzuki', Yasutake Ohishi', 'Toyato Technological Inst., Japan. Tunable soliton and dispersive wave (DW) are generated by pumping a tellurite microstructured optical fiber near the zero dispersion wavelength. The soliton is redshifted to 1828.7 nm, and the DW is blueshifted to 1315.5 nm.

JW2A.29

Highly Efficient Dispersive Wave Emission in a Tellurite Microstructured Optical Fiber, Tonglei Cheng¹, Xiaojie Xue¹, Dinghuan Deng¹, Takenobu Suzuki¹, Yasutake Ohishi¹; ¹ofmlab, Japan. We demonstrate a highly efficient, stable and tunable dispersive wave emitted by the soliton in a tellurite microstuctured optical fiber. The conversion efficiency is over ~65%.

JW2A.30

Measuring M² values for On-Wafer Vertical Cavity Surface Emitting Lasers, William North¹,

David Chacko¹, Peter Zeidler¹, Janice Blane¹, Kirk Ingold¹, Brian Souhan¹, James J. Raftery¹; ¹USA Military Academy, USA. We report on M² measurements taken for on-wafer vertical cavity surface emitting lasers (VCSELs). We measured M² for oxide-confined VCSELs and photonic crystal (PhC) VCSELs of similar lasing aperture sizes.

ce JW2A.31

Study of Two-Dimensional Photonic Crystals and Photonic Crystals Slabs with Triangular Geometry, Erik P. Navarro Baron¹, Juan Vasco-Cano^{2,3}, Herbert Vinck-Posada¹; 'Universidad Nacional de Colombia, Grupo de Óptica e Información Cuántica, Colombia; ²Departamento de Física, Universidade Federal de Minas Gerais, Brazil; ³DISSE - INCT de Nanodispositivos Semicondutores, Brazil. In this work, we have done a study of band structures and eigenmodes of bidimensional photonic crystal and photonic crystals slabs of triangular air holes embedded in dielectric media in a hexagonal lattice.

JOINT FiO/LS

JW2A • Joint FiO/LS Poster Session II—Continued

JW2A.32

Dispersion tailoring of a crystalline whispering gallery mode microcavity for octave-spanning Kerr frequency comb, Yosuke Nakagawa¹, Takumi Kato¹, Wataru Yoshiki¹, Yuta Mizumoto¹, Yasuhoro Kakinuma¹, Takasumi Tanabe¹; ¹Keio Univ., Japan. We demonstrate the octave spanning optical Kerr frequency comb generation in the dispersion-tailored crystalline whispering gallery mode microcavity with a numerical simulation. We tailor the dispersion by shaping the microcavity into 'a goblet form.'

JW2A.33

Wavelength Independency of Orbital Angular Momentum (OAM) Channels in Spatially Multiplexed Systems, Syed H. Murshid', Saud Alanzi', Bilas Chowdhury'; 'Florida Inst. of Technology, USA. The wavelength independency of OAM is presented showing that the location of spatially multiplexed (SDM) optical channels carrying OAM is independent of the wavelength of light.

JW2A.34

Dual mode and wavelength-division multiplexing, Tadesse S. Mulugeta¹, Mahmoud S. Rasras¹; 'Masdar Inst. Of Science and Technology, United Arab Emirates. Simultaneous mode and wavelength division multiplexing is proposed using integrated asymmetric directional coupler and multimode interference waveguide. Using numerical simulations, the device exhibits low insertion loss of 1.2dB and a cross-talk of -18dB.

JW2A.35

Band structure of honeycomb annular photonic crystal slabs, Cristian J. Mora Montano¹, Herbert Vinck-Posada¹, Juan Vasco-Cano²; ¹Universidad Nacional de Colombia, Colombia; ²Universidade Federal de Minas Gerais, Brazil. We investigated the behavior of the band structure for a honeycomb annular lattice in a photonic crystal slab. Through GME structural parameters that maximize the band gap are characterized.

JW2A.36

Gate in a Nonlinear Subwavelength Dielectric

Waveguide Array, Gregorio Mendoza Gonzalez¹, Erwin A. Marti-Panameno¹; ¹Facultad de Ciencias Físico Matemáticas, Benemérita Univ Autonoma de Puebla, Mexico. In this work we present numerical results regarding the possibility to control the output position of the light in nonlinear arrays of subwavelength dielectric parallel waveguides. The main result is an AND logic gate due the interaction of two input beams.

JW2A.37

Technical Advantages for Weak-Value Amplifi-

cation, Julian Martinez¹, Gerardo Viza¹, Gabriel Alves², Andrew Jordan¹, John Howell²; ¹Univ. of Rochester, USA; ²Universidade Federal do Rio de Janeiro, Brazil. We measure beam deflections of an optical beam by monitoring the dark port in a Sagnac interferometer (weak-value technique) or by focusing the entire beam onto a split detector (standard technique). The weakvalue technique performs favourable in precision when external modulations are present.

JW2A.38

Enhancement of Cross Phase Modulation Via a Resonating Cavity: Semiclassical Descrip-

tion, Julian Martinez', John Howell'; 'Univ. of Rochester, USA. A classical description of cavity-based cross phase modulation in a ladder atomic system shows that large single-photon detuning offers enhancement proportional to the finesse of the resonator. The approach has a self-defined far-off-resonance effective cooperativity of unity.

JW2A.39

Quantum States in the Multipole Approach to

Maxwell Theory of Light, Michele Marrocco'; ¹ENEA, Italy. Fundamental aspects of quantum optics are reproduced within the multipole approach to Maxwell theory of light. Results are given for Fock states, vacuum field and photon statistics of chaotic and coherent light. JW2A.40

An analytical approach for calculating the FWM idler and signal wavelengths in a graded index multimode optical fiber, Elham Nazemosadat², Hamed Pourbeyram^{1,3}, Arash Mafi^{1,3}; ¹Dept. of Physics & Astronomy, Univ. of New Mexico, USA; ²Dept. of Electrical Engineering and Computer Science, Univ. of Wisconsin-Milwaukee, USA; ³Center for High Technology Materials, Univ. of New Mexico, USA. We present a simple yet powerful analytical approach for calculating the four-wave mixing signal and idler wavelengths in a graded-index multimode optical fiber using the core radius, core-cladding index step, and mode group numbers.

JW2A.41

Measurement of Polarisability of Liquid using Fiber Optic Refractive Index Sensor, Raju M Esakki Muthu', Ashwin Kumar Kuchibhotla', Kumar Ravi', Badrinath Vadakkapattu Canthadai', Vengalrao Pachava², 'Dept. of Physics, Vidya Jyothi Inst. of Technology, India; 'Dept. of Physics, National Inst. of Technology - Warangal, India. This work demonstrates the measurement of polarisability of liquid using a simple intensity modulated optical fiber sensor based on change in refractive index of the medium surrounding the fiber.

JW2A.42

Controlling Second Harmonic Generation with Counterpropagating Light, Amy L. Lytle¹, Etienne Gagnon¹; ¹Franklin & Marshall College, USA. Experimental and numerical results verify the microscopic influence of coun- terpropagating light on the phase of the nonlinear polarization wave, providing detailed understanding of an all-optical method for quasi-phase matching.

JW2A.43 Withdrawn.

JW2A.44

Supercontinuum Generation in Fluoride Fibers Pumped By a 2 µm O-switched Laser, Lai Liu¹, Kenshiro Nagasaka¹, Yasutake Ohishi¹, Takenobu Suzuki¹; ¹Toyota *Technological Inst., Japan*. We experimentally realized mid-infrared supercontinuum generation in 8-m-long single mode fluoride fiber pumped by a 2 µm nanosecond Q-switched fiber laser with bandwidth about 2000 nm. The spectra broadening mechanism is modulation instability.

JW2A.45 WiO

Dual-Beam Optical Injection in Multimode Vertical-Cavity Surface-Emitting Lasers, Andrew Briggs¹, Aashu Jha¹, Hong Lin¹; ¹Bates College, USA. We have experimentally explored dynamics of a multimode vertical-cavity surface-emitting laser subject to two-frequency orthogonal optical injection. Microwave signals are obtained in the double polarization switching and frequency locking regime.

JW2A.46

Virtual Photon Subtraction with Noisy Source in Continuous-Variable Quantum Key Distribution, Zhengyu Li¹, Xiang Peng¹, Hong Guo¹; 'Peking Univ., China. We propose a non-Gaussian postselection method to emulate the photon subtraction in continuous-variable quantum key distribution which extends the transmission distance. A method to further improve the performance for noisy source is also presented.

JW2A.47

A Wide-band Slow Light Regime Realized by Genetic Photonic Crystal Coupled Resonator Waveguides, Yiming Lai¹, Momchil Minkov², Vincenzo Savona², Romuald Houdré³, Antonio Badolato¹; ¹Dept. of Physics and Astronomy, Univ. of Rochester, USA; ²Lab of Theoretical Physics of Nanosystems, Ecole Polytechnique Federale de Lausanne EPFL, Switzerland; ³Institut de Physique de la Matiere Condensee, Ecole Polytechnique Federale de Lausanne EPFL, Switzerland. We present experimental results on the transmission and the bandstructure of novel coupled resonator optical waveguides (CROWs) in 2D photonic crystals. The CROWs were optimized by genetic algorithm and feature high group index-bandwidth product.

JW2A.48

Changing the Degree of Polarization of a Light Beam by Interferometric Path Information, Mayukh Lahiri¹, Armin Hochrainer¹, Gabriela Lemos^{1,2}, Radek Lapkiewicz¹, Anton Zeilinger^{1,2}, 'IVCQ, Faculty of Physics, Unix. of Vienna, Austria; ²IQOQI, Austrian Academy of Sciences, Austria: We present the results of an experiment in which the degree of polarization of a photon beam emerging from the output of a two-path interferometer is controlled by modulating the interferometric path information.

JW2A.49

Design of Highly Nonlinear Planar Waveguide for Supercontinuum Generation, Ajeet Kumar¹, Than Singh Saini¹, Ravindra K. Sinha¹; ¹Delhi Technological Univ., India. We have designed a rib waveguide structure in highly nonlinear As₂Se₃ glass for mid-IR broadband supercontinuum generation. Proposed structure possesses nonlinear coefficient as high as 14190 W⁻¹Km⁻¹ with 5.82 ps/nm.km dispersion at 2900 nm.

JW2A.50 WiO

Near-Field Imaging and Spectroscopy of Gold Nanoantenna, Deirdre Kilbane¹, Anna-Katherina Mahro¹, Pascal Melchior¹, Stefan Mathias¹, Martin Aeschlimann¹; ¹Physics, Univ. of Kaiserslautern, Germany. Near-field imaging and spectroscopy of ring resonators is performed with photoemission electron microscopy and a tuneable femtosecond laser source. Phase- and time-resolved near-field imaging is achieved with an actively stabilized interferometer.

JW2A.51

A Unique Observation of Power Play in the Instability Induced Supercontinuum Generation in Saturable Nonlinear Media, Nithyanandan K'; 'Pondicherry Univ., India. The supercontinuum generation is observed to behave in a unique in saturable nonlinearity, such that the broadband is observed at shortest distance for pumping at saturation power, in comparison to all other pump power configurations.

JOINT FIO/LS

JW2A • Joint FiO/LS Poster Session II—Continued

JW2A.52

Towards Quantum Frequency Conversion, Oscar Jimenez¹, Yiming Lai², Julio Cesar Garcia Melgarejo¹, Jose J. Sanchez Mondragon¹, Kartik Srinivasan³, Antonio Badolato²; ¹INAOE, Mexico: ²Univ. of Rochester, USA: ³CNST, NIST, USA. We developed a high efficiency, low-loss and high fidelity quantum frequency conversion. The objective was to transduce photons emitted by guantum dots from NIR wavelengths (λ >1.1µm) to visible wavelengths (λ <0.70 μ m), where singlephoton silicon detectors perform best.

JW2A.53

Highly Birefringent PCF Based Micro-displacement Sensor Using Tapered Fiber, Jitendra Dash¹, Sumit Dass¹, Rajan Jha¹; ¹I.I.T. Bhubaneswar, India, We report a highly birefringent (HiBi) PCF based modal interferometer assisted with a tapered single mode fiber for micro displacement sensing. The displacement sensitivity of the low cost sensor is found to be 0.01 dBm/um.

JW2A.54

Numerical Investigation of Optical Sampling with CMOS Compatible Waveguides in C-Band Wavelengths, Mahmoud Jazayerifar¹; ¹Technische Universität Berlin, USA. Optical sampling based on four wave mixing in silicon and silicon nitride nano-waveguides is numerically studied. It is shown that optical sampling at high rates (~ 100 GHz) with typical straight silicon and silicon nitride waveguides is feasible.

JW2A.55

Two-Photon Amplification In Semiconductor-Superconductor Structures, Raja Marjieh¹, Evyatar Sabag¹, Alex Hayat¹; ¹Technion, Israel. We study a new effect of Cooper-pair-based twophoton gain in semiconductor-superconductor structures, showing broadband enhancement of singly- and fully-stimulated ultrafast two-photon gain. These effects can have important implications in optoelectronics and in coherent-control applications.

JW2A.56

Phase Shift Signal Analysis for Bitapered Fiber Sensors, Joseph W. Haus¹, Daniel Jauregui Vazquez², Amit W. Ben Harush Negari¹, Juan M. Sierra Hernandez², Diego W. Garcia Mina¹, Branden King¹, Karolyn Hansen¹; ¹Univ. of Dayton, USA; ²Electronics, Univ. of Guanajuato, Mexico. Experimental transmission spectrums from bitapered optical fiber sensor system provide signal data over a range of wavelengths. The signals are analyzed using a Fourier decomposition method to extract the phase of the complex signal, which shows high sensitivity measurements.

JW2A.57

Tripartite Mechanical Entanglement in Quan-

tum Optomechanical Systems, Monirul Hasan¹, Matthew J. Woolley1; 1School of Engineering and Information Technology, Univ. of New South Wales, Australia. Electromagnetic cavity modes are useful for the control of macroscopic mechanical oscillators in the quantum regime. In a system of three mechanical modes coupled to three cavity modes, one can prepare and detect entangled states.

JW2A.58

Enhancement of Wavelength Selectivity of

Color Holograms Based on Surface Plasmons, Pavel Hartman¹, Zuzana Chlebounová¹, Marek Škeren¹; ¹Czech Technical Univ. in Prague, Czech Republic. Setup for enhancement of wavelength selectivity of transmission holographic filters based on surface plasmon is presented. Volume grating is used on the input side of the device for modifying the dispersive properties of the element.

JW2A.59

Second-Harmonic Generation in Highly Dispersive Media: Consequences of Dispersion on the Maker Fringes Method, Serge Gauvin¹; ¹Université de Moncton, Canada. The standard formalism of second-harmonic generation appears inadequate in the case of highly dispersive nonlinear materials. The inaccuracy can be as high as 30 %. A more general but still simple formalism is described and appears preferable when the Maker fringes method is used.

JW2A.60 WiO

Five mode groups EDFA for Mode Division

Multiplexing, Ankita Gaur¹, Vipul Rastogi¹; ¹Dept. of Physics, Indian Inst. of Technology Roorkee, India. We propose a few-mode EDFA for amplification of 5 mode groups with less than 2.2 dB DMG over C-band using fundamental mode pumping. The annulus core EDF is studied using annulus and extra annulus doping.

JW2A.61

A Two-Level Atom as a Coupler of Cross Cavities, Julio Cesar Garcia Melgarejo¹, Nestor Lozano-Crisostomo¹, Dayana H. Peñalver Vidal², Ponciano Rodriguez-Montero¹, Jose J. Sanchez Mondragon¹; ¹Inst Nac Astrofisica Optica Electronica, Mexico; ²Universidad Politécnica de Amozoc, Mexico. We analyze the short and long-term behavior of the coupling between two cross cavities due to their interaction with a two-level atom.

JW2A.62

Photonic waveform generator by linear shaping of four spectral sidebands, Julien Fatome¹, Christophe Finot¹; ¹Universite de Bourgogne, France. Changing the optical phase difference between four spectral sidebands is sufficient to synthesize various pulse shapes. Experiments at 40 GHz confirm that high quality parabolic, triangular or flat-top temporal intensity profiles can be achieved.

JW2A.63 WiO

Characterization of Metallic and Dielectric Thin Films Using Surface Plasmon Resonance and the Abeles - Brewster Technique, Yuliana M. Espinosa-Sánchez¹; ¹Centro de Investigaciones en Optica AC, Mexico. We presented the design and implementation of θ -2 θ system which can be used in its surface plasmon resonance mode or can be adapted to Abeles-Brewster technique. Using this system it is possible to characterize metallic and dielectric thin films.

JW2A.64

Performance Enhancement of Evanescentfield Based Optical Waveguide Bio-sensors Using Metal Under-cladding, Ranjeet Dwivedi¹, Manoj Kumar¹, Arun Kumar¹; ¹Indian Inst. of Technology, Delhi, India, A thin metal undercladding is shown to significantly enhance the evanescent-field in the cover region of an optical waveguide. Using this, a multimode interference based compact bio-sensor, having very high sensitivity (2500 nm/RIU) is proposed.

JW2A.65

The Dual-Tapered Fiber Sensors coated with

Nanoparticles, Sean Sung-Yen Juang¹, Ming-Hui Chen¹, Wei-Jie Chen¹, Nan-Kuang Chen², Hsiang-Chen Chui¹; ¹National Cheng Kung Univ., Taiwan; ²National United Univ., Taiwan. We reported the design of the dual-tapered fibers. After depositing the nanoparticles on the tapered regions, the localized surface-plasmon resonance may induce the absoprtion spectra. This compact sensor can perform real-time refractive index sensing.

JW2A.66

Localized defect modes in a nonresonantly pumped exciton-polariton condensate, Ting-Wei Chen¹, Wen-Feng Hsieh², Szu-Cheng Chena¹: ¹Dept. of Optoelectric Physics, Chinese Culture Univ., Taiwan; ²Dept. of Photonics and

Inst. of Electro-Optical Engineering, National Chiao Tung Univ., Taiwan. The localized defect modes in a nonresonantly pumped polariton condensate are investigated. Under an attractive defect, a hyperbolic cotangent solution is remarkably stable, which doesn't exist in atomic systems and has never been reported before.

JW2A.67

High Performance Binary Blazed Polysilicon Grating Coupler with a Silicon Nitride Filling

Layer, Huai Yi Chen1; 1Huafan Univ., Taiwan. A binary blazed poly-silicon grating coupler with a silicon nitride filling layer was proposed. Compared with typical binary blazed silicon grating coupler, it can reduce the coupling angle and retain a high fiber coupling efficiency.

JW2A.68

Architectural Improvements of a Novel Embedded MSM Photodetector, Guillermo Fernando Camacho Gonzalez¹; ¹INAOE, Mexico. We introduce a realistic improvement on a recent proposed embedded MSM photodetector that reduces the back reflected light to 11.04%. Therefore carriers creation efficiency increases, enhancing the sensitivity. This is useful for communication optoelectronic systems.

JW2A.69 WiO

Pulse Recycling and Weak Value Metrology, Courtney Byard¹, Trent Graham¹, Andrew Jordan^{2,3}, Paul G. Kwiat¹; ¹Univ. of Illinois at UC, USA; ²Physics and Astronomy, Univ. of Rochester, USA: ³Center for Coherence and Quantum Optics, Univ. of Rochester, USA. Recycling undetected photons in a weak measurement can substantially improve the signal-to-noise ratio. We demonstrate a preliminary improvement by a factor of 1.36 over a system with no recycling, potentially reaching a factor of 4.

JW2A.70

Dimensional Effect on Poling in Lithium Niobate, Peter Bullen¹, Hsu-Cheng Huang¹, Richard Osgood¹; ¹Columbia Univ., USA. We investigated the dimensional effect on poling in lithium niobate. By poling samples of varying thickness (25–500 µm), we found that thickness affected both domain broadening and coercive field significantly.

JW2A.71 Withdrawn.

JW2A.72

Implementation of 3-bit Synchronous Up Counter using Mach-Zehnder Interferometer for Optical Signal Processing, Santosh Kumar¹, Ashish Bisht¹, Divya Sharma², Angela Amphawan³; ¹Dept. of Electronics & Communication Engineering, DIT Univ., India; ²Dept. of Electronics & Communication Engineering, Shoolini Univ., India; ³InterNetWorks Research Lab, School of Computing, Universiti Utara Malaysia, Malaysia. An optical 3-bit synchronous up counter is demonstrated by using optical T flip flops and logic gates based on electro-optic effect of Mach Zehnder Interferometers, which can be cascaded for higher bit counting operation

JOINT FIO/LS

JW2A • Joint FiO/LS Poster Session II—Continued

JW2A.73

Implementation of an Optical Binary Cell of Random Access Memory based on Electro-Optic Effect in Mach-Zehnder Interferomete, Santosh Kumar¹, Ashish Bisht¹, Sanddep Sharma¹, Sanjeev Kumar Raghuwanshi³, Angela Amphawan²; 'Dept. of Electronics & Communication Engineering, DIT Univ, India; ²Inter/Net-Works Research Lab, School of Computing, Universiti Utara Malaysia, Malaysia; ³Dept. of Electronics Engineering, Indian School of Mines, India. An optical binary storage cell of a random access memory is demonstrated for Read/Write operation based on the electro-optic effect of Mach Zehnder Interferometer which can be arrayed to form optical memory units.

JW2A.74

Protein Hydrogel Immobilization via Multiphoton Plasmonic Lithography (MPPL), Bharath Bangalore Rajeeva¹, Mingsong Wang¹, Linhan Lin¹, Yuebing Zheng¹; ¹The Unix. of Texas at Austin, USA. We regioselectively localize protein hydrogels over the hot spots of single gold nanotriangle using MPPL, and track the immobilization using dark-field scattering spectroscopy. This technique can be exploited to study biological interactions in the nanoscale.

JW2A.75 Simplified Bond-Hyperpolarizability Model Explanation of the Electric-Field-Induced

Second-Harmonic Generation for Different Facets in Si, Adalberto Alejo-Molina¹, Jesús Escobedo-Alatorre¹, Kurt Hingerl², Edvaart Sethaziz Jatirian-Foltides¹; ¹CIICAp, UAEM, Mexico; ²Center for Surface and Nanoanalytics, Johannes Kepler Univ., Austria. In this work we discuss the respond from different facets of the Si crystal for the nonlinear phenomenon Electric-Field-Induced Second-Harmonic (EFISH) Generation. The technique to describe it is Simplified Bond-Hyperpolarizability Model.

JW2A.76

Effect of Illumination Length pn the Optical Absorption of Armchair Graphene Nanoribbons, Mahbub Alam¹², Paul Voss¹²; 'Georgia

Inst. of Technology, France; ²UMI 2958 Georgia Tech-CNRS, France. We study nanoscale optical illumination of semiconducting armchair graphene nanoribbons. The optical absorption undergoes a sharp transition to the long-ribbon limit at approximately the de Broglie wavelength of the valence band electrons.

JW2A.77 WiO

Zero backscattering by ellipsoidal single nanoparticle, Reena Dalal', Preeti Rani', Yogita Kalra', Ravindra K. Sinha'; 'Delhi Technological Univ., India. We report zero backscattering by ellipsoidal nanoparticles. Using generalized Kerker's (GK) condition, we have analyzed light is scattered in the forward direction for the particular wavelength of 908nm in our design, suppressing the backscattering completely.

JW2A.78

A Digital-like On-Chip Photonics Sensor, Osama AL Mrayat', Mahmoud S. Rasras'; 'Masdar Inst. of Science and Technolo, United Arab Emirates. We propose compact photonics sensor with Iow limit of detection (LOD) and large dynamic range. It integrates cascaded-coupled micro ring resonators with Echelle Grating. Employing a thermo-optic tuning, LOD of 26x10⁴ RIU can be achieved.

JW2A.79

Electronic spectra and lateral photocurrent

in Si/Ge heterostructures with quantum dots , Yurii Hyrka¹; ¹OSA Student chapter, Ukraine. The work generalizes the results of studies of morphological, structural, optical and electrical properties of SiGe/Si anoheterostructures. It is shown that the photoconductivity of nanoheterostructures SiGe/Si in the infrared range depending on the component composition.

JW2A.80

Development of a Thermal Lens Microscope for Asphaltene Analysis., David Hernandez¹, Gustavo Martínez¹, Marco Ferreira¹, Vincent Piscitelli¹, Lorenzo Echevarria², ¹Universidad Central de Venezuela, Venezuela, Bolivarian Republic of; ²Universidad Simon Bolivar, Venezuela, Bolivarian Republic of. This paper shows the development of a thermal lens microscope to measure the response of thermal lens in different Venezuelan asphaltene solutions.

JW2A.81

Dual-wavelength tunable Er/Yb double-clad doped Q-switched fiber laser, Manuel Duran-

Sanchez¹, Ricardo . Álvarez-Tamayo¹, Olivier Pottiez², Baldemar Ibarra-Escamilla¹, Georgina Beltrán-Pérez³, Yazmin E. Bracamontes-Rodríguez³, Evgeny A. Kuzin¹; ¹Optics, INAOE, Mexico, ²Optics, CIO, Mexico; ³FCFM, BUAP, Mexico. A tunable dual-wavelength Q-switched ring cavity fiber laser with Er/Yb double-clad fiber is presented. Laser simultaneous wavelengths tuning is performed by fiber Bragg gratings compression/strain. Maximal laser lines separation is -4 nm.

JW2A.82 WIO

Optogalvanic spectroscopy measurements of the electric field strength in a hydrogen glow discharge, Verónica González Fernández¹, Luis María Fuentes¹, Klaus Grützmacher¹, M.Concepción Pérez¹, M. Inmaculada de la Rosa¹; ¹Universidad de Valladolid, Spain. A high-resolution spectroscopy method is used in order to measure the electric field distribution in

a hollow cathode *glow discharge* in hydrogen. JW2A.83 WiO

Intra-cavity Generation of Laguerre-Gauss Laser Beams Via a High-Joss Circular Mask, Katelyn Hinman ¹, Jessica P. Young¹; ¹Arkansas Tech Univ, USA. Generation of Laguerre-Gauss laser beams via a null within the laser cavity is demonstrated. The null is created by a high-Joss mask. The relationship between mode order and mask to beam diameter ratio is discussed.

JW2A.84 WiO

Detection of Trace Materials Concomitant with Fingerprints Using a Multispectral UV Camera, Wenli Huang', Barry Shoop', Augustus Fountain III²; ¹Electrical Engineering and Computer Science, US Military Academy, USA; ²Edgewood Chemical Biological Center, Aberdeen Proving Ground, USA. This paper presents the algorithms in detecting trace materials on fingerprints using a multi-wavelength UV camera. We evaluate two competitive approaches: The error diffusion neural network (EDN) and orthoqonal space projection (OSP).

JW2A.85

All optical mode controllable Er-doped fiber random laser with distributed Bragg gratings, Wei Li Zhang¹, Rui Ma¹, Chenghao Tang¹, Yunjiang Rao¹, Xiaopei Zeng¹, Zinan Wang¹, Yuan Gong¹; ¹Univ. of Electronic Science and Technology of China, China. An all-optical method to control lasing modes of Er-doped-fiber random lasers is proposed. Local gain distribution in the laser is perturbed by lateral injecting control light, and active coherent random modes selection is realized.

NOTES

Wednesday, 21 October

California	Valley	Crystal	Gold	Empire
		FiO		
11:00–12:30 FW3A • General Optical Sciences I Presider: Igor Jovanovic; Pennsylvania State Univ., USA	11:00-12:30 FW3B • Integrated Photonics for Communications: Datacenters and Networks I Presider: Keren Bergman; Columbia Univ., USA	11:00–12:30 FW3C • Frequency Comb Generation and Applications Presider: Juerg Leuthold; ETH Zurich, Switzerland	11:00–12:30 FW3D • Quantum Optical Measurement and Technologies I Presider: Ian Walmsley; Univ. of Oxford, UK	11:00–12:30 FW3E • Novel Integrated Optical Structures Presider: Edris Sarailou, Univ. of Central Florida, CREOL, USA
 FW3A.1 • 11:00 Experimental and Simulation Study of Polarization Singularities Using Birefringent Crystal Interferometer, Sunil Vyas¹, Yoko Miyamoto¹; ¹The Univ. of Electro-Communications, Japan. Experimental and simulation studies are performed to study transformation of phase singularity into polarization singularity using birefringent crystal interferometer. Present results may be useful in understanding evolution of singularity. FW3A.2 • 11:15 Lithography-free visible metasurface absorbers with tunable dielectric spacers, Kai Liu¹, Nan Zhang¹, Dengxin Ji¹, Haomin Song¹, Xie Zeng¹, Olaoqiang Gan¹; ¹State Univ. of New York at Buffalo, USA. We differentiate the spacerdependent peak shift in coupled and decoupled super absorbing metasurfaces based on magnetic resonance and interference mechanism, respectively, which was experimentally validated by low-cost lithography-free fabrications. 	FW3B.1 • 11:00 Invited O Photonics Integrated Circuits for Access and Transport Network, Young-Kai Chen'; 'Alcatel- Lucent Bell Labs, USA. In this talk, we will review recent advances in the photonic integrated semiconductor as well as the emerging CMOS- compatible silicon platform, to enable access and transport network.	FW3C.1 • 11:00 Invited C Broadband Frequency Combs on a Photonic Chip Using Soliton Induced Cherenkov Radia- tion, Tobias J. Kippenberg'; ' <i>Ecole Polytech-</i> <i>nique Federale de Lausanne, Switzerland</i> . This tark will review microresonator based optical frequency combs, that allow access to large (GH2) repetition rates, large power per comb line and chipscale integration. I will review recent progress in generating temporal solitons in a SiN microresonator. This process, along with soliton induced Cherenkov radiation can be used to create deterministically, low phase noise, numerically predictable combs that span 2/3 of an octave from a single CW laser.	FW3D.1 • 11:00 Invited O Photonic Quantum Simulation & Emulation, Andrew G. White ^{1,2} ; 'Univ. of Queensland, Australia; ² Centre for Engineered Quantum Systems & Centre for Quantum Computing and Communication Technology, Australia. Here we examine the state-of-play in photonic quantum simulation and emulation. We discuss recent ad- vances in photon technology, notably sources, detectors, and nonlinear interactions, and the implications for large-scale implementations, e.g. in the BosonSampling problem.	FW3E.1 • 11:00 Nanostructured Polarizer Array for Infrared Wavelengths, Carol Baumbauer ¹ , Sean Nicolay- sen ¹ , Benjamin Moon ¹ , Marquette Stevenson ¹ , David L. Dickensheets ¹ , Wataru Nakagawa ¹ ; 'Montana State Univ. USA. Nanostructured polarization filters for wavelengths around 1.55 µm have been designed, fabricated and charac- terized. The design approach can be adapted to other wavelengths in the infrared and to create filter arrays with spatially varying characteristics. FW3E.2 • 11:15 FW3E.2 • 11:15 Experimental Investigation of a Nanoplas- monic Air-Slot Coupler Toward Dense Optical Integrated Circuits, Rami A. Wahsheh ¹ , Zhaolin Lu ² , Mustafa Abushagur ² ; <i>Princess Sumaya</i> Univ. for Technology, Jordan; ² Rochester Inst. of Technology, USA. Experimentally, we demonstrate that light can be coupled from a silicon waveguide into a plasmonic waveguide using an air-slot coupler. The theoretical and experimental results at 1550 nm are about 85% and 40%, respectively.
FW3A.3 • 11:30 Modification of Light Transmission Channels by Inhomogeneous Absorption in Random Media, Seng Fatt Liew ¹ , Hui Cao ¹ ; ¹ Applied Physics, Yale Univ, USA. We investigate the ef- fects of spatially inhomogeneous absorption on transmission eigenchannels of light in random media. The high transmission channels circum- vent absorbing regions and experience less attenuation compared to uniform absorption.	FW3B.2 • 11:30 Invited MEMS-Enabled Scalable Silicon Photonic Switches, Ming C. Wu', Tae Joon Seok', Sangyoon Han', Niels Quack'; 'Univ. of Cali- fornia Berkeley, USA. Large-scale integrated photonic switches (50x50 and 64x64) have been realized by combining silicon photonics with efficient MEMS switching mechanisms. These switches are based on passive crossbar architecture, which is fundamentally more scal- able than other switches.	FW3C.2 • 11:30 C Comb characterization of Erbium All-fiber Hy- brid Mode-locked ultra-short pulse Ring laser for Frequency Metrology, Vladimir A. Lazarev ¹ , Alexander Krylov ² , Dmitriy Dvoretskiy ¹ , Stanislav Sazonkin ¹ , Alexey Pnev ¹ , Dmitriy Shelestov ¹ , Valery Karasik ¹ , Alexey Kireev ³ , Mikhail Gubin ³ ; ¹ Bauman Moscow State Technical Univ., Russia; ² Fiber Optics Research Centre, Russia; ³ P.N. Lebedev Physical Inst. of the Russian Academy of Sciences, Russia. Stable 92.6 fs dechirped self-similar pulses were obtained at 1560 nm with 11.2 mW average output power. Similariton laser has low repetition rate deviation at 1 - 10 ³ s, a single comb linewidth of 110 kHz and high reliability, which makes it promising for further development of the stabilized comb.	FW3D.2 • 11:30 C Photon Temporal Modes as a Complete Framework for Quantum Information, Michael G. Raymer ¹ , Benjamin Brecht ² , Dileep V. Reddy ¹ , Christine Silberhorn ² ; 'Univ. of Oregon, USA; ² Univ. of Paderborn, Germany. We propose a quantum information framework that employs field-orthogonality of single-photon temporal modes. The three requirements-generation of resource states, the targeted and efficient manipulation of TMs, and their detection and characterization-can be fulfilled with current technology.	FW3E.3 • 11:30 C Coherent Perfect Absorption in a Silicon Ring Resonator, Jacob M. Rothenberg ¹ , Christine Chen ¹ , Kreen Bergman ¹ , Richard Osgood ¹ , Ja- son Ackert ² , Andrew Knights ² , Richard Grote ^{1,3} ; ¹ Dept. of Electrical Engineering, Columbia Univ, USA; ² Dept. of Engineering Physics, McMaster Univ, Canada; ³ : Dept. of Electrical and Systems Engineering, Univ. of Pennsylvania, USA. We present the first experimental demonstration of coherent perfect absorption (CPA) in an integrated device. By leveraging the effects of CPA, phase-controlled modulation is achieved in a silicon photonic ring-resonator with an extinction of 8.12dB.

Wednesday, 21 October

FW3F • Novel Light Generation and

Presider: Julien Fatome; Universite de

Manipulation in Fiber Devices I

Sacramento

Hillsborough

Piedmont

LS

LW3H • Novel Photonics Presider: Jesse Wilson, Duke Univ., USA

LW3H.1 • 11:00 Invited

11:00-12:45

Bright Tunable Photonic-Crystal-Fibre Light Sources in the Deep and Vacuum Ultraviolet, Philip S. Russell¹, Amir Abdolvand¹, Xin Jiang¹, Nicolas Joly¹, John Travers¹; ¹Max Planck Inst. for the Science of Light, Germany. PCFs have been revolutionizing VUV and DUV light sources. He-filled hollow-core PCF has produced narrow and broad-band light in the VUV (down to 113 nm), and solid-core ZBLAN PCF a supercontinuum down to 200 nm.

11:00-12:30 LW3I • Computational Optical Imaging II

Presider: William Rhodes; Florida Atlantic Univ., USA

LW3I.1 • 11:00 Invited

A Learning Approach to Optical Tomography, Demetri Psaltis¹: ¹Ecole Polytechnique Federale de Lausanne, Switzerland. We form the 3D image of an object by minimizing the difference between the prediction of a network simulating the propagation of light through the object and the experimental measurement.

ear Guided Optics, Arnaud Mussot¹, Alexandre Kudlinski¹,

FW3F.1 • 11:00 Invited

Bourgogne, France

11:00-12:30

Matteo Conforti¹, Abdelkrim Bendahmane¹, Flavie Braud¹, Francois Copie¹, Shaofei Wang¹, Stefano Trillo²; ¹Univ Lille 1 Laboratoire PhLAM, France; ²Dipartimento di Ingegneria, Università di Ferrara,, Italy. We investigate theoretically and experimentally basic nonlinear effects such as soliton propagation or modulation instability in what we called topographic optical fibers, i.e. fibers which parameters are longitudinally modulated.

Topographic Optical Fibers : New Perspectives in Nonlin-

11:00-12:30 FW3G • Symposium Honoring Adolf Lohmann I Presider: Joseph Mait; US Army Research Lab, USA

FW3G.1 • 11:00 Invited

FiO

Adolf Lohmann and his Contributions to Optics, Joseph W. Goodman¹; ¹Stanford Univ., USA. J.W. Goddman's first meeting with Adolf will be reviewed and he will discuss a few of Adolf's many papers that were especially important to him.

FW3F.2 • 11:30

Polarization properties of the solitons in the supercontinuum generation in twisted fiber pumped by ns pulses, Ariel Flores-Rosas^{2,1}, Sergio Mendoza-Vazquez², Berenice Posada-Ramirez², Orlando Diaz-Hernadez², Jesus G Escalera-Santos²; ¹INAOE, Mexico; ²Fisica, Universidad Autonoma de Chiapas, Mexico. We investigate the polarization of solitons formed by the pulse breakup process at pumping by ns-long pulses in standard fiber with circular birefringence introduced by fiber twist, the fiber twist mitigates the random linear birefringence.

FW3G.2 • 11:30

Multiplexing Computer-Generated Volume Holograms, Rafael . Piestun¹, Hayan Wang¹; ¹Univ. of Colorado at Boulder, USA. Volumetric computer-generated holograms enable independent multiplexed control of the amplitude and phase of the optical field. Angular, wavelength and phase-shift multiplexing designs are implemented using scattering theory and projection algorithms in three-dimensional Fourier space.

LW3H.2 • 11:30 Invited

Title to be Determined, Xiang Zhang¹; ¹Univ. of California Berkeley, USA. Abstract not available.

LW3I.2 • 11:30 Invited

Accurate 3D Nanoscale Imaging of Dipole-like Emitters, Matthew D. Lew1; 1Dept. of Electrical and Systems Engineering, Washington Univ. in St. Louis, USA. Engineered point spread functions and modern image processing enable optical microscopes to measure the 3D position and orientation of single molecules with nanoscale precision and accuracy. Recent developments in methodologies and applications are discussed.

California	Valley	Crystal	Gold	Empire
		FiO		
FW3A • General Optical Sciences I—Continued	FW3B • Integrated Photonics for Communications: Datacenters and Networks I—Continued	FW3C • Frequency Comb Generation and Applications— Continued	FW3D • Quantum Optical Measurement and Technologies I—Continued	FW3E • Novel Integrated Optical Structures—Continued
FW3A.4 • 11:45 Molding the Flow of Light in Photonic Topo- logical Insulators, Xiao-Dong Chen ² , Jian-Wen Dong ^{1,2} ; ¹ Univ. of California Berkeley, USA; ² School of Physics and Engineering, Sun Yat-Sen Univ., China. We experimentally demonstrate the spin-filtered feature and robust transport of edge states in metacrystal waveguide. In addi- tion, dispersion-immune photonic topological insulator is achieved by staggered photonic metacrystals.		FW3C.3 • 11:45 C Coherent Dual-Comb Mode-locked Fiber Laser based on a Birefringent Ring Cavity, Xin Zhao ¹ , Zheng Gong ¹ , Ya Liu ¹ , Yuli Yang ¹ , Guoqing Hu ¹ , Zheng Zheng ^{1,2} ; ¹ School of Elec- tronic and Information Engineering, Beihang Univ, China; ² Collaborative Innovation Center of Geospatial Technology, China. Based on a passively mode-locked fiber cavity with relatively large birefringence, it is demonstrated that coherent dual-comb emissions with dual soliton pulse trains of slightly different repeti- tion rates and nearly orthogonal polarization can be generated.	FW3D.3 • 11:45 C Resolving Subwavelength Variations in the Response of NbN Nanowire Single Photon Detectors, Jelmer J. Renema', Qiang Wang', Rosalinda Gaudio ² , Andreas Engel ³ , Martin P van Exter ¹ , Andrea Fiore ² , Michiel J. de Dood'; ¹ Universiteit Leiden, Netherlands; ² Eindhoven Univ. of Technology, Netherlands; ³ Univ. of Zurich, Switzerland. We use quantum detector tomography to identify photon assisted vortex entry as the photon detection mechanism in superconducting NbN nanowires. We exploit the polarization dependence to resolve the response of the nanowire with subwavelength resolution.	FW3E.4 • 11:45 Ring Modulators in Standing-wave and Pau tial Standing Wave Operation on a Matcher Interdigitated p-n Junction for Enhanced El ficiency, Fabio Pavanello ¹ , Xiaoge Zeng ¹ , Mar T. Wade ¹ , Milos A. Popovic ¹ ; ¹ Univ. of Colorad at Boulder, USA. We propose microring modu lators in (quasi)standing-wave operation witi interdigitated p-n junctions matched to optica field nodes/antinodes, allowing higher modula tion efficiency and speed than traveling-wave designs.Full-standing-wave and grating assisted geometries are proposed.
FW3A.5 • 12:00 Time Resolved Spectroscopy on Thin Layers of Black Phosphorus, Ryan J. Suess ^{1,2} , Moham- mad M. Jadidi ^{1,2} , Thomas E. Murphy ^{1,2} , Martin Mittendorff ¹ ; Inst. for Research in Electronics & Applied Physics, Univ. of Maryland, USA; ² Dept. of Electrical & Computer Engineering, Univ. of Maryland, USA. We report transient transmission spectra for multi-layer black phosphorus. The data exhibits fast transient photobleading and subsequent pump-induced absorption charac- terized by multiple relaxation times. Polarization resolved measurements reveal a high anisotropy in the optical response.	FW3B.3 • 12:00 Invited O Multimode VCSELs vs Si Photonics in the Data Center: A Techno-economical Comparison, Daniel Mahgerefteh ¹ , Craig Thompson ¹ ; ¹ Finisar Corporation, USA. Will Si photonics replace MM VCSELs in the data center? We attempt to answer this question by comparing the two technologies based on their application space, cost structure, transmission reach, and power consumption.	FW3C.4 • 12:00 Invited Fast Random Event Detection Using Opti- cal Frequency Comb, Vahid Ataie ¹ ; ¹ Univ. of <i>California, San Diego, USA.</i> Application of tunable optical parametric frequency combs in spectral decomposition and detection of the non-repetitive high-speed and low SNR signal is discussed. A significant improvement in detection sensitivity is reported for the newly introduced receiver architecture.	FW3D.4 • 12:00 WIO Quantum Networks based on Cold Rydberg Atoms and an Optical Nanofiber, Krishnapriya S.R ¹ , Tridib Ray ¹ , Sile Nic Chormaic ¹ ; 'Okinawa Inst of Science & technology, Japan. We discuss recent experimental progress towards realizing a quantum network based on Rydberg atoms trapped around an optical nanofiber. Initial tests are designed to demonstrate the formation of Rydberg atoms next to the dielectric surface.	FW3E.5 • 12:00 C Nonlinear Magnetic Scattering from Polyme Micro-ring Resonators, Ayan Chakrabarty ¹ Cheng Zhang ¹ , Alexander A. Fisher ¹ , Elizabeth F. Dreyer ¹ , Qiaochu Li ¹ , L.Jay Guo ¹ , Stepher Rand ¹ ; ¹ Univ. of Michigan, USA. Optical scatter ing from a high-Q polymer micro-ring resonato shows evidence of intense magnetic interac- tions due to a second order magneto-electric nonlinearity.
FW3A.6 • 12:15 Observation of Different Types of Spatial Correlations in the Biphoton's Fourier Plane, Omar Calderon ¹ , Jefferson Florez ¹ , Juan Villa- bona ¹ , Alejandra Valencia ¹ ; ¹ Universidad de los Andes, Colombia. We report an experiment based on non-collinear type-II spontaneous parametric down-conversion that shows how the type of spatial correlation changes if the biphoton's Fourier plane is scanned vertically or horizontally.			FW3D.5 • 12:15 Beating the Standard Quantum Limit in Quan- tum Metrology despite Noise, Jan Kolodynski ¹ , Jonatan Bohr Brask ² , Rafael Chaves ^{3,4} , Marcin Markiewicz ⁵ , Antonio Acin ^{1,6} , Madalin Guta ⁷ , Rafal Demkowicz-Dobrzanski ⁵ ; ¹ ICFO - The Inst. of Photonic Sciences, Spain; ² Inst. for Theoretical Physics, Univ. of Geneva, Switzerland; ³ Inst. of Physics, Univ. of Freiburg, Germany; ⁴ Inst. for Theoretical Physics, Univ. of Cologne, Germany; ⁵ Faculty of Physics, Univ. of Warsaw, Poland; ⁴ ICREA - Institucio Catalana de Recerca i Estudis	FW3E.6 • 12:15 Silicon NanoDimers for Magnetic and Electr Field Hotspots, Reuben M. Bakker ¹ , Dmit Permyakov ² , Ye Feng Yu ¹ , Dmitry Markovich Ramón Paniagua-Domínguez ¹ , Leonard Goi zaga ¹ , Anton Samusev ² , Yuri Kivshar ^{2,3} , Bor Luk Yanchuk ¹ , Arseniy Kuznetsov ¹ ; ¹ Data Storag Inst., Singapore; ² ITMO, Russia; ³ Nonlinear Phy ics Centre, Australia. Dielectric nanostructur with a high refractive index are of interest fu ultimate control of light in the near-field. W demonstrate, experimentally and numerical
12:30–13:30 Lunch Break (on you	ur own) and Unopposed Exhibit Only T	ime, Exhibit Hall, Imperial Ballroom	Avancats, Spain; 'School of Mathematical Sci- ences, Univ. of Nottingham, UK. We review the quantum information theory program analysing the impact of noise in quantum metrology,	the existence of electric and magnetic fiel hotspots near silicon nanodimers.
12:30–14:00 VIP Inc	lustry Leaders Networking Event, Clu	b Regent, Lobby Level	which has led to the first uncorrelated-noise model allowing for limitless quantum enhance- ment of measurement precision, consequently	
13:00–14:30 Meet th	e Editors of the APS Journals, Exhibit	: Hall, Imperial Ballroom	yielding an improved <i>atomic magnetometry</i> experimental proposal.	

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Wednesday, 21 October

Glen Ellen	Sacramento	Hillsborough	Piedmont
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FW3F • Novel Light Generation and Manipulation in Fiber Devices I—Continued	FW3G • Symposium Honoring Adolf Lohmann I—Continued	LW3H • Novel Photonics—Continued	LW3I • Computational Optical Imaging II— Continued
FW3F.3 • 11:45 Spectral Analogue of the Soliton Effect Compression: Spectral Self-Compression, Levon K. Mouradian ¹ , Armine Grigoryan ¹ , Aghavni Kutuzyuan ¹ , Garegin Yesayan ¹ , Minas Sukiasyan ¹ , Hrach Toneyan ¹ , Aram Zeytunyan ^{1,2} , Ruben Zadoyan ³ , Alain Barthelemy ⁴ ; ¹ Yerevan State Univ., Armenia; ² Univ. of California, Irvine, USA; ³ Newport Technology & Ap- plications Center, USA; ¹ Dept. Photonique, XLIM Institut de Recherche, France. The nonlinear process of the pulse spec- tral self-compression in a medium with anomalous dispersion, the spectral analogue of the soliton effect compression, is introduced on the basis of our experimental observation and detailed numerical analysis.	FW3G.3 • 11:45 Computer Generated Hologram in Spatial Division Multiplexing, Shoam Shwartz ¹ , Michael A. Golub ¹ , Shlomo Ruschin ¹ ; ¹ Physical Electronics, Tel Aviv Univ., Israel. We report here on generic space-division multiplexing and demultiplexing units for high-throughput transmission in multimode fibers, with the aid of computer generated hologram spatial filters.		
FW3F.4 • 12:00 Invited Optical Vortices in Fiber, Siddharth Ramachandran ¹ ; ¹ Boston Univ., USA. Long lived orbital angular momentum (OAM) states of light in fibers have recently been enabled by a class of so-called ring-fiber designs. We review their potential applications in areas ranging from telecommunications to nanoscale microscopy.	FW3G.4 • 12:00 Spectral shaping using nonlinear computer-generated holograms, Roy Shiloh', Anat Leshem', Ady Arie ¹ , ' <i>Tel-Aviv</i> <i>Univ., Israel.</i> Computer-generated holograms can shape the spatial domain, but also the spectral domain. We shape light spectra using quadratic nonlinear optics, in theory and experiment. These are readily extended to other wave-related fields, such as plasmonics.	LW3H.3 • 12:00 Invited Imaging Surface Plasmon Polaritons in Nanostructures with Transient Absorption Microscopy, Gregory V. Hart- land ¹ , Paul Johns ¹ , Mary S. Devadas ¹ ; 'Dept. of Chemistry and Biochemistry, Univ. of Notre Dame, USA. Surface Plasmon Polaritons (SPPs) are electromagnetic waves that propagate at metal-dielectric interfaces. In this paper transient absorption microscopy is used to image SPPs in gold nanowires, and study how they couple between nanostructures.	LW31.3 • 12:00 Invited The Remarkably Flexible Ptychographic Data Set, Andrew Maiden', Peng Li'; 'Univ. of Sheffield, UK. Ptychography is an experimentally simple form of phase retrieval with a sur- prisingly flexible dataset. Here I describe how 3D imaging, partial coherence, missing data and positioning errors can be accommodated within the ptychographic scheme.
	FW3G.5 • 12:15 Planar Micro-Optics: Key Enabling Technology for Semi- conductor Industry, Reinhard Voelkel'; 'SUSS MicroOptics SA, Switzerland. Photolithography enabled semiconductor industry to shrink the minimum features on microchips below 20 nanometers today. Planar micro-optical elements play a decisive role for light shaping and metrology within high-end projection lithography systems.	LW3H.4 • 12:30 Tunable Polariton Lasing in ZnO Whispering Gallery Mi- crocavity, Liaoxin Sun ¹ , Hongxing Dong ² , Zhanghai Chen ² , Xuechu Shen ¹ , Wei Lu ¹ ; ¹ Shanghai Inst. of Technical Physics , China; ² Fudan Univ, China. A tunable polariton lasing is realized in a single ZnO tapered whispering gallery (WG) microcavity at room temperature. A tunable range of 100 meV and a minimum lasing threshold appeared at positive detuning of 42 meV are observed.	
12:30	D-13:30 Lunch Break (on your own) and Unoppo	osed Exhibit Only Time, Exhibit Hall, Imperial Ba	llroom
	12:30–14:00 VIP Industry Leaders Net	working Event, Club Regent, Lobby Level	
	13:00–14:30 Meet the Editors of the Al	PS Journals, Exhibit Hall, Imperial Ballroom	
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Wednesday, 21 October

California	Valley	Crystal	Gold	Empire
		FiO		
13:30–15:30 FW4A • General Optical Sciences II Presider: Laszlo Veisz, Max- Planck-Institute fur Quantenoptik, Germany	13:30–15:30 FW4B • Integrated Photonics for Communications: Datacenters and Networks II Presider: Young-Kai Chen; Alcatel- Lucent Bell Labs, USA	13:30–15:00 FW4C • Symposium on Optical Remote Sensing for the Climate Presider: Ian Coddington; NIST, USA	13:30–15:30 FW4D • Quantum Optical Measurement and Technologies II Presider: Marco Bellini; Istituto Nazionale di Ottica - CNR, Italy	13:30–15:30 FW4E • Optical Coherence Tomography Presider: Alvaro Casas-Bedoya, Univ. of Sydney, Australia
FW4A.1 • 13:30 Visible and Near Infrared Polarization Con- trol with Vanadium Dioxide, Alain Hache ¹ , Alexandre Doucet ¹ , Patrick Cormier ¹ , Jacques Thibodeau ¹ , Tran Vinh Son ¹ ; 'Universite de Moncton, Canada. Vanadium dioxide, a material used in many filtering and imaging applications in the near-infrared, is shown to possess the capability of modifying the polarization of visible and infrared light. FW4A.2 • 13:45	FW4B.1 • 13:30 Tutorial O Optical Interconnects for Computing Systems and the Need for Integration, Bert J. Offrein ¹ , Jonas Weiss ¹ , Antonio La Porta ¹ , Roger Dangel ¹ , Folkert Horst ¹ , Norbert Meier ¹ , Daneil Jubin ¹ ; ¹ /BM Research GmbH, Switzerland. Optical interconnects play an increasingly important role in the intra-system communication in com- puting systems. To continue to scale system performance, new electro-optical integration approaches are required that increase band- width while reducing cost.	FW4C.1 • 13:30 Invited Precision Atmospheric Trace Gas Monitoring with Frequency Comb Lasers, Gregory B. Rieker ^{2,1} , Fabrizio Giorgetta ¹ , William Swann ¹ , Paul Schroeder ² , Jonathan Kofler ³ , Laura C. Sinclair ¹ , Esther Baumann ¹ , Gabrielle Petron ³ , Colm Sweeney ³ , Peter P. Tans ³ , Ian R. Cod- dington ¹ , Nathan R. Newbury ¹ ; 'National Inst. of Standards and Technology, USA; ² Univ. of Colorado at Boulder, USA; ³ National Oceanic and Atmospheric Administration, USA. Accu- rate monitoring of trace gases requires high	FW4D.1 • 13:30 Invited O Integrated Photonic Systems for Quantum Technologies, Ian A. Walmsley ¹ , Ben Metcalf ¹ , Peter Humphreys ¹ , Steve Kolthammer ¹ , Peter Smith ² , James Gates ² ; ¹ Univ. of Oxford, UK; ² ORC, Univ. of Southampton, UK. Complex quantum systems reveal new phenomena that cannot be studied using classical simulation. In- tegrated photonics provides as effective means to engineer such systems, with direct application to quantum simulation and measurement.	FW4E.1 • 13:30 Invited Towards All-Optical Quantification of Ciliar Physiology, Michael Choma'; 'Yale Univ., USA Cilia are organelles that generate microfluidi flows in the lungs, central nervous system, ann Fallopian tubes. Quantitative flow diagnosti remain immature. I will present a comprehensiv optical imaging-based approach for quantifying cilia flow physiology.

Extremely Efficient Two-Photon Absorption in Small Donor-Acceptor Substituted Organic Molecules, Ivan Biaggio¹, Marten Beels¹; ¹Lehigh Univ., USA. The two-photon absorption cross section of optimized donor-acceptor substituted small molecules can become extremely large when compared to the size of the molecules and also when compared to the fundamental quantum limit

Wednesday, 21 October

FW4A.3 • 14:00 Holographic Surface Gratings in Photorefrac-

tive Materials, Partha P. Banerjee¹, Dean Evans², Ujitha Abeywickrema¹; ¹Univ. of Dayton, USA; ²WPAFB, Materials Directorate, USA. Existence of surface gratings on a photorefractive material is proved by analyzing reflected diffraction orders of an incident reading beam. A novel technique is used to numerically eliminate the Fabry-Perot effect from diffracted orders.



Bert Jan Offrein received his Ph.D. in nonlinear integrated optics from the University of Twente in 1994. He then joined IBM Research - Zurich establishing integrated optical devices for DWDM networks. In 1998, he changed to JDS Uniphase as a technical marketing and yield engineer for 980 nm pump lasers. One year later he returned to IBM Research - Zurich to lead the photonic device technology group realising state of the art adaptive integrated optical components. Since 2004, Bert Jan Offrein is the manager of the photonics group, addressing silicon photonics, electro-optic integration for system scaling and nano-photonic structures for quantum photonics.

FW4C.2 • 14:00 Applications of Cavity Ring Down Spec-

sensitivity, drift-free instruments. Dual frequency

comb spectroscopy is a promising technique for

kilometer-scale open-path monitoring of trace

gases, owing to its low systematic uncertainty,

high stability, and absorption-model-based

calibration.

troscopy in the Earth Sciences, Chris W. Rella¹; ¹Picarro, Inc., USA. We present new and emerging applications of Cavity Ring Down Spectroscopy for the study of carbon, nitrogen, and hyrdrological cycles, focusing on applications for which high accuracy and precision are kev requirements.

FW4D.2 • 14:00 Linear Optical Quantum Metrology with Single Photons, Keith Motes², Jonathan Olson¹, Evan Rabeaux¹, Jonathan Dowling¹, Stephan Olson³, Peter Rohde⁴; ¹Dept. of Physics & Astronomy, Louisiana State Univ., USA; ²Dept. of Physics and Astronomy, Macquarie Univ., Australia; ³Dept. of Physics, Boise State Univ., USA; ⁴Faculty of Engineering & Information Technology, Univ. of Technology, Australia. We show that a passive, linear-optical interferometer (fed with only single-photon inputs and utilizing single-mode photodetection) is capable of beating the shotnoise limit, providing a potential pathway forward to practical quantum metrology.

FW4E.2 • 14:00 WIO

OCT-Based Quantification of the Effect of a Drug on the Motility of Mammary Organoids, Xiao Yu^{1,2}, Richard Blackmon¹, Patricia Casbas-Hernandez³, Melissa A. Troester^{3,4}, Amy Oldenburg^{1,2}; ¹Dept. of Physics and Astronomy, Univ. of North Carolina Chapel Hill, NC, USA; ²Biomedical Research Imaging Center, Univ. of North Carolina Chapel Hill, NC, USA; ³Dept. of Epidemiology, Gillings School of Global Public Health, Univ. of North Carolina Chapel Hill, USA; ⁴Lineberger Cancer Center, Univ. of North Carolina Chapel Hill, NC, USA. We quantified the effect of doxorubicin on the motility of mammary epithelial cells in 3D cultures by Optical Coherence Tomography. The measured cellular motility decreased in a time-dependent fashion after exposure to doxorubicin.

Sacramento

Hillsborough

Piedmont

FiO

13:30–15:30 FW4F • Novel Light Generation and Manipulation in Fiber Devices II Presider: Siddharth Ramachandran; Boston Univ., USA

FW4F.1 • 13:30 Invited

Nonlinear Polarization Manipulation in Optical Fibers, Pierre-Yves Bony¹, Massimiliano Guasoni¹, Marin Gilles¹, Antonio Picozzi¹, Stéphane Pitois¹, Guy Millot¹, Stefan Wabnitz², Julien Fatome¹, ¹CNRS - Université Bourgogne Franche-Comté, France; ²Univ. of Brescia, Italy. We describe the self-organization of light state-of-polarization in optical fiber based on a nonlinear cross-polarization interaction between an input signal and its backward replica. Several proof-of-principles for telecom applications are reported. 13:30–15:30 FW4G • Symposium Honoring Adolf Lohmann II Presider: Rafael Piestun; Univ. of Colorado at Boulder, USA

FW4G.1 • 13:30 Invited

When the Difference Between Coherent and Incoherent Imaging Begins to Blur, William T. Rhodes¹, ¹Florida Atlantic Univ. USA. We generally think that distinctions between coherent and incoherent imaging are clear, but they are not always so. I give examples of blurring of distinctions, beginning with two that Adolf Lohmann and I worked on.

13:30–15:30 LW4H • Semiconductor NanoOptics II Presider: Sangam Chatterjee; Philipps Universitat Marburg, Germany

LW4H.1 • 13:30 Invited

Optical Properties of van der Waals Heterostructures, Tony F. Heinz¹; 'Stanford Univ., USA. Monolayers of van-der-Waals materials can be combined to form a wide variety tailored heterostructures. In this paper, we discuss the resulting optical and optoelectronic properties of such heterostructures and how they relate to the properties of the isolated layers.

LS

13:30–15:30 LW4I • Advanced Imaging Presider: David Cuccia; Modulated Imaging Inc, USA

LW4I.1 • 13:30 Invited

Spatial Frequency Domain Optical Imaging of Brain Blood Flow and Metabolism, Robert H. Wilson¹, Bruce J. Tromberg¹; ¹Univ. of California Irvine, USA. Intrinsic signal optical imaging of rat cortex reveals unique information about neurovascular function in real time. Broadband spatial frequency domain imaging (SFDI) provides a platform for quantitative assessment and localization of intrinsic signals and cortical metabolism.

FW4F.2 • 14:00

Six Mode Selective Photonic Lanterns Using Either Step or Graded Index Fibers, Juan Carlos Alvaradp Zacarias^{1,2}; ¹CREOL, USA; ²Óptica, Instituto Nacional de Astrofisica, Óptica y Electrónica, Mexico. Low-loss all-fiber photonic lantern (PL) capable of selectively exciting the first six fiber modes of a multimode fiber (4 LP) using both step and graded index are demonstrated.

FW4G.2 • 14:00

Minimizing Bias in a Millimeter Wave Imager, Joseph N. Mait', Christopher A. Schuetz², Richard D. Martin³, Shouyuan Shi², Dennis W. Prather²; ¹US Army Research Lab, USA; ²Dept. of Electrical and Computer Engineering, Univ. of Delaware, USA; ³Phase Sensitive Innovations, USA. We present a procedure for designing two point spread functions in a millimeter wave imaging system whose difference produces a desired response with minimum bias and maximum signalto-noise ratio.

LW4H.2 • 14:00 Invited

Attosecond Electron Response in Nanoscale Interfaces, Peter Hommelhoff', Takuya Higuchi', '*Friedrich-Alexander-Universität Erlangen, Germany.* A subcycle of intense laser light can force an electron to travel over nanometer lengthscales. We employ this ultrafast control of attosecond electron dynamics as key ingredient of nanoscale devices potentially operating at optical bandwidth.

LW4I.2 • 14:00 Invited

Focusing Light Deep in Tissue with Ultrasound Guidestars,

Puxiang Lai^{1,2}, Lihong V. Wang¹, 'Washington Univ. in St Louis, USA; ²Interdisciplinary Division of Biomedical Engineering, Hong Kong Polytechnic Univ., Hong Kong. In this talk, we propose to use ultrasound, in the form of either ultrasonic encoding or photoacoustic sensing, as noninvasive localized guide stars to achieve optical focusing in deep tissue and tissue-like scattering media. Wednesday, 21 October

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FW4A • General Optical Sciences II—Continued	FW4B • Integrated Photonics for Communications: Datacenters and Networks II—Continued	FW4C • Symposium on Optical Remote Sensing for the Climate—Continued	FW4D • Quantum Optical Measurement and Technologies II—Continued	FW4E • Optical Coherence Tomography—Continued
FW4A.4 • 14:15 Multi-Security Scheme Combining Chaotic Modulation and Masking using Acousto-Optic Feedback Devices, Monish R. Chatterjee ¹ , Fares S. Almehmadi ¹ ; ¹ Univ. of Dayton, USA. An input signal is encrypted onto a chaotic carrier in a hybrid Bragg cell and added to a separately generated chaotic mask with independent en- cryption keys. Simulations indicate considerable enhancement in system performance vis-à-vis security.	FW4B.2 • 14:15 Invited O Optics for Large Scale Datacenters, Hong Liu ¹ ; ¹ Google, USA. We give an overview of intercon- nect requirements for large scale datacenters. We then present the scaling challenges of of various optical technologies to meet the per- formance and efficiency requirements of ever increasing bandwidth.		FW4D.3 • 14:15 Demonstration of Frequency Dependent Squeezing in the Audio Frequency Band, To- moki Isogai', Eric Oelker', John Miller', Maggie Tse', Lisa Barsotti', Nergis Mavalvala', Matthew Evans'; ' <i>MIT, USA</i> . We use a high finesse opti- cal cavity to rotate squeezed light quadrature as function of frequency in the audio band, which is suitable for improving the sensitivity of gravitational-wave detectors over a wide frequency band.	FW4E.3 • 14:15 Real-time swept-source Doppler optical coherence tomography for middle ear diag- nostics, Dan MacDougall ¹ , Thomas Landry ¹ , Manohar Bance ¹ , Jeremy Brown ¹ , Robert Adam- son ¹ ; ¹ Dalhousie Univ., Canada. Transtympanic middle ear imaging is a very promising applica- tion of optical coherence tomography (OCT). We present progress on the development of a real-time swept-source OCT imaging system with Doppler vibrography for in-clinic functional imaging in live patients.
FW4A.5 • 14:30 Depolarizing Molecular Rotations in Magneto- Electric Scattering, Alexander A. Fisher ¹ , Ayan Chakrabarty ¹ , Elizabeth F. Dreyer ¹ , Stephen Rand ¹ ; ¹ Univ. of Michigan, USA. Nonlinear light scattering experiments in solid and liquid dielectrics with a range of electronic structures point to the importance of molecular rotations in enhancing second-order magneto-electric interactions and generating depolarization.		FW4C.3 • 14:30 Prited Measuring Greenhouse Gases from Aircraft and Spacecraft using Lidar, James B. Abshire'; 'NASA Goddard Space Flight Center, USA. This presentation will discuss the application of lidar approaches to remotely measure the column abundance of CO2 and other atmospheric greenhouse gases from space. It will discuss recent airborne campaigns, ongoing work and plans for future space missions.	FW4D.4 • 14:30 O Multi-Correlated Two-Photon States within an Integrated Quantum Frequency Comb, Michael Kues ¹ , Christian Reimer ¹ , Benjamin Wetzel ^{1,9} , Piotr Roztocki ¹ , Lucia Caspani ^{1,2} , Fabio Grazioso ¹ , Yaron Bromberg ⁸ , Brent E. Little ³ , William J. Munro ⁴ , Sai T. Chu ⁵ , David J. Moss ^{1,6} , Roberto Morandotti ^{1,7} ; 'INRS-EMT, Canada; ² School of Engineering and Physical Sciences, Heriot-Watt Univ, UK; ³ Xi'an Inst. of Optics and Precision Mechanics of CAS, China; ⁴ NTT Basic Research Labs, NTT Corporation, Japan; ⁵ Dept. of Physics and Material Science, City Univ. of Hong Kong, China; ⁴ School of Electrical and Computer Engineering, RMIT Univ, Australia; ¹ Inst. of Flundamental and Frontier Sciences, Univ. of Electronic Science and Technology of China, China; ⁸ Dept. of Applied Physics, Yale Univ. of Sussex, UK. By superimposing two dif- ferent spontaneous four-wave mixing processes inside a bi-modally pumped CMOS-compatible microring resonator, we report the generation of four-mode two-photon multi-correlated states and measure two-photon entanglement.	FW4E.4 • 14:30 WiO Optical Coherence Tomography and Profilom- stry based on Optical Sampling by Cavity Tun- ing, Lin Yang', Lingze Duan'; 'Univ. of Alabama in Huntsville, USA. We report the demonstration of an optical coherence tomography and surface profilometry system based on optical sampling by cavity tuning. Our scheme provides a simple, cost-effective solution for rapid, large-depth noninvasive imaging.

Wednesday, 21 October

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FW4F • Novel Light Generation and Manipulation in Fiber Devices II— Continued	FW4G • Symposium Honoring Adolf Lohmann II—Continued	LW4H • Semiconductor NanoOptics II— Continued	LW4I • Advanced Imaging—Continued
FW4F.3 • 14:15 WiO Experimental Realization of Principal Modes in a Mul- timode Fiber with Strong Mode Mixing, Wen Xiong ¹ ; ¹ Yale Univ., USA. We experimentally realized the principal modes in a multimode fiber with strong mode mixing. We further studied the spectral bandwidths of these principal modes and their dependence on the delay time and mode dependent loss.	FW4G.3 • 14:15 Invited Fractional Fourier and Linear Canonical Transforms in Optics, Uriel Levy ³ , David Mendlovic ¹ , Haldun M. Ozaktas ² ; ¹ Tel Aviv Univ., Israel; ² Bilkent Univ., Turkey; ³ The Hebrew Univ. of Jerusalem, Israel. Fractional Fourier and linear canonical transforms are linear integral transforms that find widespread use in many areas of science and engineering. We review basic properties, including those in phase space, and their applications to optics.		
FW4F.4 • 14:30 Mapping the Uniformity of Optical Microwires Using Phase-Correlation Brillouin Distributed Measurements, Desmond Chow ¹ , Joël Cabrel Tchahame Nougnihi ² , Andrey		LW4H.3 • 14:30 Invited Ultrafast Hole Relaxation and Induced Biexciton Response in Single CdSe/ZnSe Quantum Dots, Denis Seletskiy ¹ , Christopher Hinz ¹ , Christian Traum ¹ , Benjamin Bauer ¹ , Alfred	LW4I.3 • 14:30 Invited New Directions in Light Sheet Microscopy, Kishan Dhola- kia'; 'Univ. of St Andrews, UK. Light sheet microscopy using propagation invariant light beams is described. In particular I

ing conditions.

Leitenstorfer¹; ¹Dept. of Physics and Center for Applied

Photonics, Univ. of Konstanz, Germany. Two-color pump-

probe studies reveal ultrafast dynamics of few-fermions in

single epitaxial CdSe/ZnSe quantum dots. Induced biexciton

absorption, sub-picosecond hole relaxation and deterministic

single photon gain are observed under appropriate pump-

Denisov¹, Jean-Charles Beugnot², Thibaut Sylvestre², Lizhu

Li³, Raja Ahmad³, Martin Rochette³, Kenny Hey Tow¹, Marcelo

A. Soto¹, Luc Thévenaz¹; ¹Inst. of Electrical Engineering, Ecole

Polytechnique Fédérale de Lausanne, Switzerland; ²Institut

FEMTO-ST, Université de Franche-Comté, CNRS UMR 6174,

France; ³Dept. of Electrical and Computer Engineering,

McGill Univ., Canada. The distributed Brillouin gain profile

of an ultrathin optical microwire made of chalcogenide-glass is characterized using a phase-modulated correlation-domain measurement technique. Method resolves variations of uniformity below 5% along a 13 cm-long microwire. Wednesday, 21 October

will describe studies using Airy beams which offer large fields

of view with high resolution and low phototoxicity.

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FW4A • General Optical Sciences II—Continued	FW4B • Integrated Photonics for Communications: Datacenters and Networks II—Continued	FW4C • Symposium on Optical Remote Sensing for the Climate—Continued	FW4D • Quantum Optical Measurement and Technologies II—Continued	FW4E • Optical Coherence Tomography—Continued
FW4A.6 • 14:45 Saturation effects on terahertz generation at the surface of InA, Etienne Gagnon ¹ , Amy L. Lytle ¹ ; ¹ Franklin & Marshall College, USA. We modify the 1D drift-diffusion equation to model the generation of terahertz from a train of ultrafast pulses at the surface of InAs. We present and compare numerical and experi- mental results.	FW4B.3 • 14:45 Invited WiO Designing Performance-Energy Optimized Silicon-Photonic Interconnected Computing Systems, Keren Bergman'; 'Columbia Univ., USA. Silicon photonic networks can offer energy-efficient communications bandwidths for scaling future computing. We describe the multi-level co-design of energy-performance optimized photonic architectures for commu- nications-intensive applications.		FW4D.5 • 14:45 C Nondestructive Detection of Traveling Opti- cal Photons in Real Time, Mahdi Hosseini ¹ , Kristin M. Beck ¹ , Yiheng Duan ¹ , Wenlan Chen ¹ , Vladan Vuletic ¹ ; ¹ Dept. of Physics and Research Lab of Electronics, MIT, USA. We nondestruc- tively observe individual optical photons in real time as they propagate through a slow-light medium. The nondestructive measurement is accomplished with another light that detects the atomic-excitation component of the slow photons.	FW4E.5 • 14:45 Spatially-Resolved ECM Nanotopology via Gold Nanorod Diffusion Mapping Using Polarization-Sensitive OCT, Richard Blackmon ¹ , Brian Chapman ² , Joseph Tracy ² , Rupinder Sand- hu ³ , Melissa A. Troester ³ , Amy Oldenburg ^{1,4} ; ¹ Physics and Astronomy, Univ. of North Carolina at Chapel Hill, USA; ² Materials Science and Engineering, North Carolina State Univ., USA; ³ Lineberger Comprehensive Cancer Center, Univ. of North Carolina at Chapel Hill, USA; ⁴ Bio- medical Research Imaging Center, Univ. of North Carolina at Chapel Hill, USA. We demonstrate using PS-OCT to sense cross-sectional ECM nanotopology by mapping spatially resolved GNR diffusion. This novel approach will enable new applications in studying ECM remodeling such as tumorigenesis.
FW4A.7 • 15:00 Giant Nonreciprocity in a Parity-Time reversal Symmetric Microstrip Dimer System, Roeny Thomas ¹ , Huanan Li ¹ , Fred Ellis ¹ , Tsampikos Kuttos ¹ ; ¹ Physics, Wesleyan Univ., USA. A giant non-reciprocal transmission is demonstrated theoretically from a pair of coupled resonators with Parity-Time symmetry due to the interplay of existing exceptional point degeneracy, and the interaction with a gyro-magnetic substrate.			FW4D.6 • 15:00 Scan-free direct measurement of an one- million-dimensional photonic state, Zhimin Shi ¹ , mohammad Mirhosseini ² , Jessica Margie- wicz ¹ , Mehul Malik ^{2,3} , Freida Rivera ¹ , Ziyi Zhu ¹ , Robert W. Boyd ^{2,4} ; ¹ Univ. of South Florida, USA; ² Inst. of Optics, Univ. of Rochester, USA; ³ Inst. for Quantum Optics and Quantum Informa- tion, Austrian Academy of Sciences, Austria, ⁴ Dept. of Physics, Univ. of Ottawa, Canada. We describe a technique that directly measures a pure quantum state of arbitrary dimensions with	FW4E.6 • 15:00 1060 nm Vernier-Tuned Distributed Bragg Reflector (VT-DBR) Laser for Swept-Source OCT, Greg Bergdoll ¹ ; ¹ CalPoly State Univ. (SLO), USA. We report the first wavelength-tunable 1060nm VT-DBR laser for use in SS-OCT applica- tions. Electrical measurements demonstrate 1-3 nanosecond step response times for wavelength tuning. Optical linewidths less than 10 MHz are measured using self-homodyne interferometry.

FW4A.8 • 15:15

Temporal Analog of Reflection and Refraction at a Temporal Boundary, Brent Plansinis¹, William R. Donaldson², Govind Agraval^{1,2}; ¹The Inst. of Optics, Univ. of Rochester, USA; ²Lab for Laser Energetics, Univ. of Rochester, USA. We show numerically and analytically that an optical pulse that crosses over a temporal boundary in a dispersive medium acts as a temporal analog of the spatial reflection and refraction at a dielectric interface.

FW4B.4 • 15:15

O-band wavelength (de-)multiplexers on SOI featuring quasi-athermal behavior and fabrication insensitiveness, Corrado Sciancalepore¹, Karim Hassan¹, Richard J. Lycett², Jacques-Alexandre Dallery³, Sebastien Pauliac¹, Julie Harduin¹, Hélène Duprez¹, Ulf Weidenmueller³, Dominic Gallagher², Sylvie Menezo¹, Badhise Ben Bakir¹; ¹CEA-Leti, USA; ²Photon Design Ltd, UK; ³Vistec ElectroBeam GmbH, Germany. We report about design, fabrication, and testing of wavelength (de-)multiplexers in the O-band. Echelle gratings on SOI featuring high wafer- and lot-level uniformity as well as while quasi-athermal Mach-Zehnder-based architectures are presented.

15:30–16:00 Coffee Break, Market Street & South Tower Foyers

FW4E.7 • 15:15

a single setting of the measurement apparatus. We demonstrate our method by measuring a million-dimensional photonic spatial state.

Bad Cavities for Good Memories: Suppression

of Four-Wave Mixing in Raman Memories,

Joseph Munns^{1,2}, Tessa F. Champion¹, Cheng

Qiu¹, Patrick M. Ledingham¹, Dylan J. Saunders¹,

Ian A. Walmsley¹, Josh Nunn¹; ¹Clarendon Lab,

Univ. of Oxford, UK; ²Controlled Quantum

Dynamics CDT, Imperial College London, UK.

Quantum memories enable the synchronisation

of photonic operations. Raman memories are a

promising platform, but are susceptible to four-

wave mixing noise. We present a demonstration

of a cavity-enhanced Raman memory, showing

suppression of four-wave mixing.

FW4D.7 • 15:15 D

Quantifying Tissue Stiffness and the Effect of Nonlinearity using Compression Optical Coherence Elastography, Wes Allen¹, Philip Wijesinghe¹, Kelsey Kennedy¹, Lixin Chin¹, David Sampson¹, Brendan Kennedy¹; 'Univ. of Western Australia, Australia. We demonstrate the modification of optical coherence elastography to advance from relative strain images to quantified tissue stiffness on the micro-scale. We highlight the nonlinear dependence of tissue stiffness on the applied load and consider how nonlinearity may help characterise soft tissues.

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FW4F • Novel Light Generation and Manipulation in Fiber Devices II— Continued	FW4G • Symposium Honoring Adolf Lohmann II—Continued	LW4H • Semiconductor NanoOptics II— Continued	LW4I • Advanced Imaging—Continued
FW4F.5 • 14:45 WiO Influence of Acousto-Optic Coupling in Nonlinear Pulse Propagation Through Tapered Fiber Optics, Catalina Hurtado Castano ¹ , Rodrigo Acuna ¹ , Pedro Torres ¹ ; ¹ Univer- sidad Nacional de Colombia, Colombia. We study the influ- ence of acousto-optic effect in nonlinear pulse propagation in tapered with two different diameters. A set of equations are used in order to compute analytically the acousto-optic coupling coefficient between the fundamental core mode and lower LP cladding modes in the structure.	FW4G.4 • 14:45 WiO Optical Beam Modal Analysis Via Generalized Two-Path Interferometry, Tanya Malhotra ¹ , Wesley E. Farriss ² , James R. Fienup ² , Ayman Abouraddy ³ , Nick Vamivakas ² ; ¹ Physics and Astronomy, Univ. of Rochester, USA; ² Inst. of Optics, Univ. of Rochester, USA; ³ Univ. of Central Florida, CREOL, The Col- lege of Optics & Photonics, USA. A one dimensional optical implementation of the fractional Fourier Transform (fFT) using programmable lenses is presented. This set-up is used to implement a proof-of-principle experiment demonstrating a spatial mode-sorting Michelson interferometer based on a fFT generalized delay line.		
FW4F.6 • 15:00 Invited Nonlinear and Nonlocal Effects on Transverse Anderson Localizations in Disordered Fibers, Claudio Conti ¹ ; ¹ /SC- CNR Dep. Physics Univ. Sapienza, Italy. Two dimensional disordered systems sustain localized modes that may interact in the presence of a nonlinear optical response. We consider the effect of nonlinearity and nonlocality on the degree of localization and on the mutual interaction of disorder induced localized states.	FW4G.5 • 15:00 Invited Optical Processing Inside a Degenerate Cavity Laser, Asher A. Friesem', Nir Davidson'; 'Weizmann Inst. of Science, Israel. Optical processing inside a degenerate cavity laser is exploited for efficient control of the spatial coherence, unique phase locking of many coupled lasers, and rapid wavefront shaping. Supporting experimental and calculated results are presented.	LW4H.4 • 15:00 Invited Phonon-mediated Scattering in Quantum dot Cavity Sys- tems, Stephen Hughes ¹ , Kaushik Roy-Choudhury ¹ ; ¹ Queen's Univ. at Kingston, Canada. We present a polaronic quantum optics approach for modelling electron-phonon scattering in semiconductor cavity-QED structures containing quantum dots. We demonstrate several applications of the theory and connect to a number of recent experiments.	LW4I.4 • 15:00 Invited Super-resolution Imaging with Airy Beams, Shu Jia'; ' <i>SUNY Stony Brook, USA</i> . We demonstrated a self-bending point spread function (SB-PSF) based on self-accelerating Airy beams for three-dimensional (3D) super-resolution fluorescence microscopy. The approach offers several-fold improvement over previously reported 3D imaging methods.

15:30–16:00 Coffee Break, Market Street & South Tower Foyers

Wednesday, 21 October

California Valley Crystal Gold Empire FiO 16:00-18:00 16:00-17:30 16:00-18:00 16:00-18:00 16:00-18:00 FW5B • Integrated Photonics for FW5C • Novel Concepts in FW5D • Polarization Imaging FW5E • General Optics in Biology FW5A • Quantum Optical Plasmonics **D** and Medicine **D** Measurement and Communications: InP Platforms Presider: Rongguang Liang, Univ. Technologies III 🖸 and Lasers Presider: Monish Chatteriee; Univ. of Arizona, UŠĂ Presider: Michael Choma; Yale Presider: Hyunseok Jeong; Seoul Presider: Ming Wu; Univ. of of Dayton, USA Univ., USA National Univ., Korea California Berkeley, USA FW5A.1 • 16:00 Invited FW5B.1 • 16:00 FW5C.1 • 16:00 FW5D.1 • 16:00 Invited FW5E.1 • 16:00 Invited Novel Photonic Quantum Computing and Monolithic Three-Section Injection-Locked Ultra-small on-chip polarization splitters Full Stokes Imaging Polarimeter, Stanley Molecular Imaging Through Centimeters of Quantum Simulation, Lee Rozema¹, Philip Pau¹, Wei-Liang Hsu¹, Jeffrey Davis¹, Xingzhou Laser for Optical Oversampled Analog-toin hybrid plasmonic waveguides, Jianjun Tissue: High Resolution Imaging with Ceren-Walther1; 1Universitat Wien, Austria. I will pres-Digital Conversion, Edris Sarailou¹, Peter Chen¹, Chengwei Sun¹, Hongyun Li¹, Qihuang Tu¹, Neal Brock², Shona Kroto², Mohammed kov Excitation, Brian W. Poque¹; ¹Dartmouth ent experimental results for the superposition Delfyett¹; ¹Univ. of Central Florida, CREOL, USA. College, USA. Cerenkov light emission in tis-Gong¹; ¹Peking Univ., China. Based on the Ibn-Elhaj³; ¹Univ. of Arizona, USA; ²4D Technolof quantum gates enabling significant com-A novel linear interferometric intensity modulalarge modal birefringence and the different ogy Corporation, USA; ³Rolic Technologies sue can be produced easily from radiotherapy putational speed-ups. I will also present the tor is demonstrated with an extremely low $V\pi$ field confinements of the transverse-electric Ltd., Switzerland. Research in liquid crystal beams, and this internal light source can be quantum simulation of two XY-interacting spins of 1.1 mV and a SFDR of 75 dB.Hz^{2/3}. This is and transverse-magnetic modes in the hybrid polymer retarder and polarizer has enabled used to create high resolution excitation reand discuss the current status of new photonic achieved by modulating the passive section of air-dielectric-metal waveguide, ultra-small onthe development of a new class of full Stokes gions within tissue for molecular imaging. This quantum technology. the injection-locked mode-locked laser. chip polarization splitters are experimentally division-of-focal-plane imaging polarimeter. The is demonstrated by imaging through full body demonstrated construction, calibration and performance of thickness of mice and rats. several polarimeters will be presented. FW5B.2 • 16:15 Invited FW5C.2 • 16:15 InP Photonic IC-based Transmitters, Receiv-Manipulating Multiple Coupling in Plasmonic ers, and Transceivers for Regional and Metro Nanoantenna Arrays, Linhan Lin¹, Yuebing Networks, Vikrant Lal¹; ¹Infinera Corporation, Zheng1; ¹University of Texas, USA. A general USA. Infinera is a pioneer in large-scale Phostrategy is developed to exploit the coorditonic Integrated Circuit technology for long-haul nated effects of multiple coupling in plasmonic DWDM systems. In this paper we report on nanoantenna arrays with metal-insulator-metal recent progress in adapting the PIC technology configuration for optimization of spectral refor the fast-growing regional and metro cloud sponse and local field enhancement. applications. FW5A.2 • 16:30 Invited FW5E.2 • 16:30 🚺 WiO FW5C.3 • 16:30 FW5D.2 • 16:30 Zero-Area Ultrashort Single Photons, Marco High-order Power Map and Low-order Lens-Optimal Design of Plasmonic Antennas for Novel Imaging Spectro-polarimeter, Chunmin

Bellini^{1,2}, Luca S. Costanzo^{1,2}, Antonio S. Coelho³, Daniele Pellegrino², Milrian S. Mendes⁴, Lucio Acioli⁴, Katiuscia Cassemiro⁴, Daniel Felinto⁴, Alessandro Zavatta^{1,2}; ¹lstituto Nazionale di Ottica - CNR, Italy; ²LENS and Dept. of Physics, Univ. of Florence, Italy; ³Departamento de Engenharia, Instituto Camillo Filho, Brazil; ⁴Departamento de Fisica, Universidade Federal de Pernambuco, Brazil. We demonstrate that the interaction of ultrashort single photons with a dense resonant atomic sample deeply modifies the temporal shape of their wavepacket mode without degrading their non-classical character, and effectively generates zero-area single-photon pulses. Protects - 10:30 Optimal Design of Plasmonic Antennas for Geometric Phase Elements, Asad Tahir', Israel De Leon', Sebastian Schulz', Jeremy Upham', Robert W. Boyd^{1,2}; 'Univ. of Ottawa, Canada; ²Inst. of Optics, Univ. of Rochester, USA. We discuss the design of V-shaped plasmonic antennas for optimal half-wave plate functionality, which in turn allows to the realization of optimal plasmonic Pancharatnam-Berry Phase Optical Elements.

Zhang?, Dingyi Wang^{2,1}, Tingkui Mu², Wenyi Ren^{2,3}, Chenlin Jia², 'Physics, Univ. of New Brunswick, Canada; ²Inst. of Space Optics and School of Sciences, Xi'an Jiaotong Univ., China; 'School of Sciences, Northwest A&F Univ., China, 'School of sciences, Northwest A&F Univ., China, Sciences innovative instrument based on Savart polariscope is proposed to simultaneously acquire image, spectrum, and full Stokes parameters of a target. The principle, scheme, and technique are discussed, and some preliminary results are presented. High-order Power Wap and Low-order Lensmeter using a Smartphone Add-on, Monica Matsumoto¹, Vitor F. Pamplona¹, Matthias Hoffmann¹, Guilherme Uzejka¹, Nathaniel Sharpe¹; ¹Eyenetra, Inc., USA. We developed a portable, low-cost, accurate, wavefront sensing lensmeter for optometry applications: the Netrometer. In addition to low-order measurements (SPH, CYL and AXIS), Netrometer portraits in real-time a power map of the perceived refractive values.

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16:00–18:00 FW5F • Novel Light Generation and Manipulation in Fiber Devices III Presider: Arnaud Mussot; Univ Lille 1 Laboratoire PhLAM, France

FW5F.1 • 16:00 Invited

Towards Raman-free Generation of Photons Pairs in Liquid Filled Hollow Core Photonic Crystal Fibres, Margaux Barbier¹, Thibault Harlé¹, Isabelle Zaquine², Philippe Delaye¹; ¹aboratoire Charles Fabry, Institut d'Optique, France; ²Telécom Paristech, Laboratoire Traitement et Communication de l'Information, France. We present a new fibered architecture for generation of correlated photon pairs, in which the deleterious influence of Raman photons has been highly reduced by filling the core of a microstructured fiber with a liquid. 16:00–18:15 FW5G • Symposium Honoring Adolf Lohmann III Presider: Ravi Athale; US Office of Naval Research

FW5G.1 • 16:00 Invited

Having Fun with Lohmann Optics, Stefan . Sinzinger¹; 'Technische Universität Ilmenau, Germany. Having fun with optics has always been one of the most important driving forces for Adolf Lohmanns ingenuity and creativity. We present some results of recent research projects and trace them back to typical Lohmann approaches.

16:30–17:30 LW5H • Semiconductor NanoOptics III Presider: Vincenzo Savona; Ecole Polytechnique Federale de Lausanne, Switzerland

LS

16:00–17:30 LW5I • Precision Laser Spectroscopy III Presider: Dylan Yost, Colorado State Univ. USA

LW5I.1 • 16:00 Invited

An XUV Dual-comb Source for Precision Spectroscopy, R. Jason Jones¹; ¹Univ. of Arizona, USA. Intracavity highharmonic generation has extended the frequency comb into the XUV spectral region. We demonstrate a dual-comb system enabling detection of individual comb teeth for a more robust approach to precision spectroscopy in the VUV/XUV.

FW5F.2 • 16:30

Soliton-based MIR generation until 2.4 µm in a CS₂-core step-index fiber, Mario Chemnitz', Martin Gebhardt², Christian Gaida², Fabian Stutzki², Jens Limpert^{2,3}, Markus A. Schmidt'; 'Inst. for Photonic Technology, Germany; ²Fiber & Waveguide Lasers, Inst. for Applied Physics, Germany; ³Helmholtz-Inst. Jena, Germany. Soliton-based MIR supercontinuum generation between 1.2 µm and 2.4 µm is presented using a highly nonlinear CS₂-core optical fiber and a 430 fs Tm-based pump source.

FW5G.2 • 16:30 Invited

Optical Interconnection - Early Concepts and Novel Approaches, Jürgen Jahns'; 'Fernuniversität in Hagen, Germany. Optical interconnection is finally coming of age. Optics offers high spatial and temporal bandwidth and the capability to reduce latency and power dissipation. Here, the early concepts and recent technology are reviewed.

LW5H.2 • 16:30 Invited

How Does One Exciton Split into Two in Organic Semiconductors?, Xiaoyang Zhu¹; ¹Columbia Univ., USA. A singlet exciton can split into two triplets with energy and spin conservation in a process called singlet fission. This lecture will discuss how singlet fission proceeds through the correlated triplet pair, also called the multiexciton (ME) state.



Femtosecond-Level Synchronization Over Kilometer-Scale Turbulent Air Paths, Laura C. Sinclair¹, Jean-Daniel Deschênes², Fabrizio Giorgetta¹, William Swann¹, Esther Baumann¹, Ian Coddington¹, Nathan R. Newbury¹; ¹NIST, USA; ²Université Laval, Canada. We have demonstrated synchronization of two optical oscillators over a turbulent 4-km air path with sub-femtosecond short timescale time offset. Over a 50-hour measurement the long timescale wander in the time offset is <±20 fs.

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FW5A • Quantum Optical Measurement and Technologies III—Continued	FW5B • Integrated Photonics for Communications: InP Platforms and Lasers—Continued	FW5C • Novel Concepts in Plasmonics—Continued	FW5D • Polarization Imaging— Continued	FW5E • General Optics in Biology and Medicine—Continued		
	FW5B.3 • 16:45 Single-longitudinal-mode lasing from a fiber cavity based on feedback from an on-chip microring resonator, Guangnan Chen ¹ , Xin Zhao ¹ , Zijun Yao ¹ , Zheng Zheng ^{1,2} ; ¹ School of Electronic and Information Engineering, Bei- hang Univ., China; ² Collaborative Innovation Center of Geospatial Technology, China. We demonstrated single-longitudinal-mode (SLM) lasing from a Fabry-Perot fiber laser cavity enabled by narrow bandwidth feedback from a high-Q (>10°) on-chip SiN microring resonator, where the remaining sidemodes are further suppressed by a saturable absorber.	FW5C.4 • 16:45 D Directional Emission of Single Photons From Nanocrystal Quantum Dots Using a Hybrid Plasmonic-Dielectric Nanoantenna, Moshe G. Harats ² , Nitzan Livneh ¹ , Shira Yochelis ¹ , Yossi Paltiel ¹ , Ronen Rapaport ^{2,1} ; ¹ The Dept. of Applied Physics, The Hebrew Univ. of Jerusalem, Israel; ² Racah Inst. of Physics, The Hebrew Univ. of Jerusalem, Israel. We design a hybrid plasmonic-dielectric nanoantenna for collimation of light emission from nanocrystal quantum dots at room temperature. We show single photon emission with a directional beam with FWHM of less than 3.5 degrees.	FW5D.3 • 16:45 O Ultra Compact Metasurface Radial/Azimuthal Polarization Converter, Zeyu Lei ¹ , Tian Yang ¹ ; 'Shanghai Jiao Tong Univ., China. We demon- strate the generation of radially or azimuthally polarized beams using an ultra compact meta- surface. The metasurface is composed of an array of gap plasmon resonators with distinct orientation angles.	FW5E.3 • 16:45 Measurement of Diffusive Transport at Liquid- Liquid Interfaces, Jose Guzman-Sepulveda', Diego E. Hurtado-Gimenez', Aristide Dogariu'; 'Univ. of Central Florida, USA. We demonstrate a fiber-based optical technique for measuring the diffusive mass transport at liquid-liquid phase boundaries in miscible mixtures. The technique is non-invasive and permits continuous evalua- tion of spatially localized dynamics.		
FW5A.3 • 17:00 C Photon Addition and Subtraction: New Strat- egies in Metrology, Bryan T. Gard ¹ , Kaushik Seshadreesan ¹ , Benjamin Koltenbah ² , Claudio Parazzoli ² , Barbara Capron ² , Richard Birrit- tella ³ , Christopher Gerry ³ , Jonathan Dowling ¹ , ¹ Louisiana State Univ., USA; ² Boeing Research & Technology, USA; ³ Lehman College, The City Univ. of New York, USA. We propose a strategy that provides resolution and sensitivity below the standard metrology limits using photon addition/subtraction at the output.	FW5B.4 • 17:00 Invited Progress in InP-based Photonic Integration, Meint Smit', Kevin Williams'; 'Technische Uni- versiteit Eindhoven, Netherlands. InP-based Photonic Integration is making rapid progress. InP-based foundry processes offer low-cost ac- cess to mature integration processes with high performance and wafer-scale integration of InP- based photonic circuits with silicon electronics is emerging.	FW5C.5 • 17:00 Hot Electrons in Plasmonic Devices: Internal Photoemission and Quantum Limitations, Imran G. Hossain ¹ , Ahmet A. Yanik ¹ ; ¹ Baskin School of Engineering, Univ. of California, Santa Cruz, USA. Hot-electrons in plasmonic devices offer an alternative route to overcome the bandgap limitations of semiconductors. However, experimentally recorded efficiencies are extremely low. We developed a bottom- up approach, and introduced high efficiency photoemission devices.	FW5D.4 • 17:00 🕑 WiO Withdrawn.	FW5E.4 • 17:00 Detection of Citrus Canker and Huanglong- bing Using Fluorescence Imaging Spectros- copy (FIS) Technique and Two Different Com- putational Methods: Support Vector Machine and Neural Network, Caio Bruno Wetterich ² , Ruan F. Neves ² , José Belasque Junior ¹ , Luis G. Marcassa ² , ¹ Esalq - Univ. of Sao Paulo, Brazil; ² Univ. of Sao Paulo, Brazil. We have used FIS to investigate citrus diseases. Texture features were extracted and used as input into classi- fiers. Results show that is possible differentiate the diseases that have similar symptoms using these two computational methods.		
FW5A.4 • 17:15 Real-Time Quadrature Measurement of a Highly Pure Single-Photon State in an Exponentially Rising Wave Packet, Hisashi Ogawa', Hideaki Ohdan', Kazunori Miyata', Masahiro a guchi', Kenzo Makino', Hidehiro Yonezawa', Jun-ichi Yoshikawa', Akira Furusawa'; 'The Univ. of Tokyo, Japan; 'The Univ. of New South Wales, Australia. We experimentally demonstrate real-time quadrature measurement of a highly pure single-photon state whose temporal wave-packet mode is in an exponentially rising shape generated by an asymmetric optical parametric oscillator.		FW5C.6 • 17:15 C Light and Rate Management in Nanowires, Zhihuan Wang ¹ , Bahram Nabet ¹ ; 'Drexel Unix, USA. We analyze optoelectronic properties of core-shell nanowires explaining how both light management and transition rate management need to be included in order to explain their ex- traordinary absorption and emission properties.	FW5D.5 • 17:15 C Signal recovery in a Mie scattering experiment with space-variant polarizations, Brandon G. Zimmerman ¹ , Thomas G. Brown ¹ ; ' <i>The Inst. of Optics, USA.</i> We describe an experimental test of the use of a (1d) space- variant polarization in Mie scattering experi- ments applied to suspensions and aerosols, with emphasis on the calibration procedures and background correction.	FWSE.5 • 17:15 O Non-linearity in Simulations of Time Resolved Imaging Using the Diffusion Approximation Solution to the Transport Equation, Edu- ardo Ortiz-Rascón ¹ , Neil C. Bruce ¹ , Antonio A. Rodríguez-Rosales ¹ , Jesús Garduño-Mejía ¹ ; <i>'Univ Nacional Autonoma de Mexico, Mexico</i> . We present results of simulations regarding time-resolved transillumination imaging. The temporal extrapolation is performed with the diffusion approximation. The dependence on time used to discriminate photons and non- linearities in the imaging process are shown.		
90	FiC	D/LS 2015 • 18–22 October 20	015			

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FW5F • Novel Light Generation and Manipulation in Fiber Devices III— Continued	FW5G • Symposium Honoring Adolf Lohmann III—Continued	LW5H • Semiconductor NanoOptics III— Continued	LW5I • Precision Laser Spectroscopy III— Continued
FW5F.3 • 16:45 Detailed analysis of amplified spontaneous four-wave mix- ing in a multimode fiber, Hamed Pourbeyram ¹² , Elham Naze- mosadat ³ , Arash Mafi ^{1,2} ; ¹ Dept. of Physics & Astronomy, Univ. of New Mexico, USA; ² Center for High Technology Materials, Univ. of New Mexico, USA; ³ Dept. of Electrical Engineering and Computer Science, Univ. of Wisconsin-Milwaukee, USA. Detailed theoretical and experimental analyses of the ampli- fied spontaneous FWM in a multimode optical fiber hint at strong non-universality of the third order Kern nonlinear tensor as a function of its frequency components.			
FW5F.4 • 17:00 In-Amplifier Mid-IR Supercontinuum Generation in a Sin- gle-mode Er-doped Fluoride Glass Fiber, Jean-Christophe Gauthier ¹ , Martin Bernier ¹ , Vincent Fortin ¹ , Simon Duval ¹ , Réal Vallée ¹ ; ¹ Universite Laval, Canada. Supercontinuum	FW5G.3 • 17:00 The Internet, "Flatland," Perfect Shuffle, and Optics, Alan Huang ¹ ; ¹ Terabit Corporation, USA. The Internet packet net- work should minimize the number of "hops" instead of total path length. This reduces the traffic, latency, power, and cost.	LW5H.3 • 17:00 Singlet-Exciton Fission Dynamics in Single-Crystalline Perfluoropentacene, Kolja Kolata', Tobias Breuer', Gregor Witte', Sangam Chatterjee'; 'Philipps Universitat Marburg, Germany. The dynamics of photoexcited carriers are studied	LW5I.3 • 17:00 Invited Fundamental Symmetries, Dark Sector and Spectroscopy, Dmitry Budker ^{2,1} ; ¹ Univ. of California Berkeley, USA; ² Johannes Gutenberg Univ., Helmholtz Inst. Mainz, Germany. I will dis- cuss some recent work in these areas involving our group and

Réal Vallée¹; ¹Universite Laval, Canada. Supercontinuum generation from 2.6 to 3.5µm is demonstrated in a singlemode fluoride EDFA seeded by an OPG source emitting 400ps pulses at 2.7µm. This approach is promising for the development of sources emitting around 3-5µm.

FW5F.5 • 17:15 Gain-spectrum flattening in a wideband parametric ampli-

fier at 1.0 µm, Xiaoming Wei¹, Sisi Tan¹, Arnaud Mussot², Alexandre Kudlinski², Kevin K. Tsia¹, Kenneth K. Y. Wong¹; ¹The Univ. of Hong Kong, Hong Kong; ²CNRS-Université Lille 1, France. We demonstrate gain-spectrum flattening in a 40-dB ultra-wideband fiber parametric amplifier at 1.0 µm by incorporating the birefringence of gain medium. A bandwidth of ~100 nm with ripple less than 8 dB is achieved.

FW5G.4 • 17:15 Invited

Adolf Lohmann's Approach to Phase-Space Optics, Jorge Ojeda-Castaneda¹; ¹Univ. of Guanajuato, Mexico. Lohmann favored the use of phase space representations for describing optical systems. We discuss the advantages and limitations associated to his approach, when describing periodic signals and imaging systems with extended depth of field.

This can be accomplished by using WDM and topologies

based on higher dimensional spaces or Groups.

LW5H.4 • 17:15

Carrier Dynamics at Pentacene/Fullerene Interfaces Investigated by Time-Resolved Photoluminescence, Robin Döring¹, Andrea Karthäuser¹, Nils W. Rosemann¹, Tobias Breuer¹, Gregor Witte¹, Sangam Chatterjee¹; ¹Faculty of Physics and Materials Sciences Center, Philipps Universitat Marburg, Germany. The dynamics of photoexcited carriers are studied in model pentacene-fullerene heterojunctions revealing signatures associated with charge-transfer states. The long lifetime of the higher-energy signature indicates robustness to non-radiative relaxation or carrier extraction mechanisms.

in single-crystalline perfluoropentace by spectrally and polar-

ization-resolved fs-pump white-light-probe spectroscopy. Our

results reveal a correlation between singlet-exciton fission and

the slip-stacked arrangements of the individual molecules.

collaborators. Please see https://budker.uni-mainz.de and

http://budker.berkeley.edu for the latest updates.

California	Valley	Crystal	Gold	Empire
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FW5A • Quantum Optical Measurement and Technologies III—Continued		FW5C • Novel Concepts in Plasmonics—Continued	FW5D • Polarization Imaging— Continued	FW5E • General Optics in Biology and Medicine—Continued
FW5A.5 • 17:30 Withdrawn.		FW5C.7 • 17:30 Parity-Time Symmetry Breaking Laser, Zi Jing Wong ¹ , Liang Feng ¹ , Ren-Min Ma ¹ , Yuan Wang ¹ , Xiang Zhang ¹ ; 'Univ. of California, Berkeley, USA. Exploration of the interplay between gain and loss in optical metamaterials can lead to novel device functionalities. Here we demonstrate a single-mode laser with unique cavity mode manipulation capability based on thresholdless parity-time symmetry breaking.	FW5D.6 • 17:30 C Berry Phase and Polarization Aberration, Russell A. Chipman'; 'Univ. of Arizona, USA. As polarized light propagates through optical systems, the state folds at each refraction. Carrying the polarization state through the optical system leads to different Berry phase accumulation along different paths. Examples of this polarization aberration on the PSF and OTF are presented.	FW5E.6 • 17:30 Printed Optical Phantoms for Whole Mouse Imaging, Brian B. Bentz ¹ , Anmol V. Chavan ¹ , Dergan Lin ¹ , Kevin J. Webb ¹ ; ¹ Purdue Univ., USA. We show reconstructed images of realistic phantoms constructed using 3D printing. This approach is versatile, aids in the development of optical imaging methods, and can be used in the calibration of live mouse imaging data.
FW5A.6 • 17:45 C Realization of sub-Planck Structure from Compass States in Time-Frequency Domain, Ludmila Praxmeyer ¹ , Chih-Cheng Chen ¹ , Popo Yang ¹ , Shang-Da Yang ¹ , Ray-Kuang Lee ¹ ; 'Na- tional Tsing Hua Univ., Taiwan. A sub-Planck structure from Compass states is reported experimentally through the correspondence between Wigner distribution function and frequency-resolved optical gating (FROG) measurement, with a time-bandwidth product smaller than that of a transform-limited pulse.		FW5C.8 • 17:45 Tamm-plasmon States in Broadband Dielec- tric-coated Mirror, Samir Kumar ¹ , Ritwick Das ¹ ; ¹ National Inst of Science Ed & Research, India. We present a simple experimental route for exciting Tamm-plasmon-polariton (TPP) modes at the interface of distributed-Bragg-reflector and metal. We also discuss the spectral mea- surements on transverse-electric and transverse- magnetic polarized TPP modes for non-normal incidence.	FW5D.7 • 17:45 C Coherence Properties of Blackbody Radia- tion and Application to Energy Harvesting and Imaging with Nanoscale Rectennas, Peter Lerner ¹ , Paul Cutler ^{1,2} , N M. Miskovskyl ^{1,2} ; <i>'SciTech Associates, LLC, USA; 'Pennsylvania</i> <i>State Univ., USA.</i> We examine the blackbody radiation emitted from an array, which can be quasi-coherent and lead to a self-image, analogous to the Talbot-Lau self-imaging with thermal radiation. Self-emitted radiation may be used for non-destructive quality control of the array or in situ biological systems.	FW5E.7 • 17:45 Optically Controlled Subcellular Diffusion, Colin Constant ¹ , Jacob Kimmel ² , Kiminobu Sugaya ² , Aristide Dogariu ¹ ; 'Univ. of Central Florida, CREOL, USA; ² Burnett School of Bio- medical Sciences, Univ. of Central Florida, USA. Optical radiation can affect actin, a globular protein that forms microfilaments and is vital for cellular motility. We show that intracellular actin movement can be preferentially enhanced along the direction of polarization without inducing phototoxicity.

17:00–20:00 OSA Science Educators' Day, Regency Ballroom I

18:00–20:00 OIDA Town Hall Forum on Biophotonics Challenges & Opportunities, Club Regent, Lobby Level

18:00–20:00 Optical Fabrication and Testing Technical Group Networking Event, Fairfield

20:00–22:00 FiO Postdeadline Paper Session The complete schedule can be found in the PDP program and the FiO Mobile App.

Solitons in Microring Resonantors: Amplification of Dispersive Waves, Cherenkov Combs and Raman Effect, Dmitry V. Skryabin'; 'Univ. of Bath, UK. We discuss several phenomena associated with the dispersive wave interaction with solitons in microring resonators, which lead to the combs of Cherenkov radiation, soliton based parametric amplification and comb broadening induced by the Raman microring solitons.

FW5F • Novel Light Generation and

Manipulation in Fiber Devices III-

Continued

FW5F.6 • 17:30 Invited

Sacramento

FW5G • Symposium Honoring Adolf

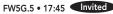
Lohmann III—Continued

Hillsborough

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Phase-Space Optics, One Photon at a Time, Harrison H. Barrett¹, Luca Caucci¹, Kyle J. Myers²; ¹Univ. of Arizona, USA; ²Center for Devices and Radiological Health, Food and Drug Administration, USA. The relationship between the Wigner Distribution Function and the spectral photon radiance is discussed for both physical optics and quantum optics. Computational methods and applications are surveyed, and photon-by-photon phase-space imagers are introduced.

17:00–20:00 OSA Science Educators' Day, Regency Ballroom I

18:00–20:00 OIDA Town Hall Forum on Biophotonics Challenges & Opportunities, Club Regent, Lobby Level

18:00–20:00 Optical Fabrication and Testing Technical Group Networking Event, Fairfield

20:00–22:00 FiO Postdeadline Paper Session The complete schedule can be found in the PDP program and the FiO Mobile App.

California	Valley	Crystal	Gold	Empire
		FiO		
	07:3	0–17:30 Registration, Market Street	Foyer	
08:00–10:00 FTh1A • General Optical Sciences III Presider: Cameron Geddes; Lawrence Livermore National Lab, USA	08:00–10:00 FTh1B • Light Manipulation in Plasmonic Structures Presider: Fabio Pavanello; Univ. of Colorado at Boulder, USA	08:00–10:00 FTh1C • Coherence, Interference and General Optics I Presider: Martin Lavery; Univ. of Glasgow, UK	08:00–10:00 FTh1D • Integrated Quantum Optics II • Presider: Jeremy L. O'Brien, Univ. of Bristol, UK	08:00–10:00 FTh1E • Optical Fiber Sensors I: Applications Presider: Olav Solgaard, Standford Univ., USA
FTh1A.1 • 08:00 Progress Toward a Spin-Optomechanics Plat- form With Vacuum Levitated Nanodiamonds, Levi Neukirch ^{1,2} , Eva von Haartman ³ , Jessica Rosenholm ³ , Nick Vamivakas ^{4,2} ; 'Dept. of Physics and Astronomy, Univ. of Rochester, USA; ² Cen- ter for Coherence and Quantum Optics, Univ. of Rochester, USA; ³ Pharmaceutical Sciences Lab Eaculty of Science and Engineering. Åbo	FTh1B.1 • 08:00 Invited O On Chip Light-vapor Interactions, Uriel Levy'; ¹ Hebrew Univ. of Jerusalem, Israel. We demon- strate light vapor interactions at the nanoscale. Two systems are described. First, we discuss the integration of guided modes with vapor. Next, we demonstate coupled atomic-plasmonic resonances.	FTh1C.1 • 08:00 Invited O Optical Metrology with Lights Orbital Angular Mometum, Martin P. Lavery ¹ , David Robertson ² , Fiona Speirits ¹ , Stephen Barnett ¹ , Miles J. Padgett ¹ ; ¹ Univ. of Glasgow, UK; ² Durham Univ., UK. We present the design and development of single piece optical systems for the efficient measurement of lights orbital angular momen-	FTh1D.1 • 08:00 Invited Photonic Quantum-information Processing with Quantum Dots in Photonic Crystals, Peter Lodahl'; 'Univ. of Copenhagen, Denmark. We discuss experimental progress on the use of single quantum dots deterministically coupled to photonic-crystal waveguides for various ap- plications in quantum-information processing.	FTh1E.1 • 08:00 Tutorial Methods for Structural Health Monitoring Based on Long-Gauge and Distributed Fiber Optic Sensors, Branko Glisic'; 'Civil and Envi ronmental Engineering, Princeton Univ., USA. Fi ber Optic Sensors (FOS) offer two unique strair sensing tools for Structural Health Monitoring (SHM) of civil structures and infrastructure: long

tum. In addition, discuss the use of such light in

the detection of rotational motion.

Akademi Univ., Finland; ⁴Inst. of Optics, Univ. of Rochester, USA. We discuss experimental efforts to construct a hybrid spin-optomechanics platform using optically levitated nanodiamonds. Current results, including optomechanical manipulation of nitrogen vacancy fluorescence and spin state are presented.

Lab, Faculty of Science and Engineering, Åbo

FTh1A.2 • 08:15

Unidirectional lasing in PT-symmetric cavities, Hamidreza Ramezani¹, Hao-Kun Li¹, Yuan Wang¹, Xiang Zhang¹: ¹Univ. of California Berkelev, USA. Using parity-time (PT) symmetry and Fano resonances we propose a new mechanism to realize unique spectral singularities with simultaneous unidirectional lasing and zero reflection mode in quasi 1D cavities.

FTh1A.3 • 08:30

Coherent Control of Photocurrent in Disordered Media, Seng Fatt Liew¹, Sebastien M. Popoff^{1,2}, Stafford W. Sheehan³, Arthur Goetschy^{1,4}, Charles A. Schmuttenmaer³, A. Douglas Stone¹, Hui Cao¹; ¹Applied Physics, Yale Univ., USA; ²CNRS LTCI, Telecom ParisTech, France; ³Chemistry, Yale Universiity, USA; ⁴ESPCI ParisTech, PSL Research Univ., Institut Langevin, France. We demonstrate experimentally coherent control of photocurrent generation in a dve-sensitized solar cell(DSSC) by shaping the wavefront of incident laser beam. Destructive interference of light enhances optical absorption and conversion to electrons.

FTh1C.2 • 08:30

Integrated Nanoantenna Labels for Rapid Security Testing of Semiconductor Circuits, Ronen Adato¹, Aydan Uyar¹, Mahmoud Zangeneh¹, Boyou Zhou¹, Ajay Joshi¹, Bennett Goldberg¹, Selim Unlu¹; ¹Boston Univ., USA. We demonstrate a multi-spectral imaging technique that utilizes integrated nanoantenna labels to enable rapid mapping of the type and location of every logical gate in an integrated circuit, and thereby detect hardware tampering.

FTh1B.2 • 08:30

Probability Distributions for Orbital Angular Momentum and Local Circulation in Vortex Beams, Anderson M. Amaral¹, Edilson L. Falcao-Filho¹, Cid B. de Araujo¹; ¹Universidade Federal de Pernambuco, Brazil. We discuss and experimentally demonstrate how to obtain the probability distributions for orbital angular momentum and local circulation in vortex beams of arbitrary shape.

FTh1D.2 • 08:30 Invited WiO

Nonlinear Integrated Quantum Optics, Linda Sansoni¹, Georg Harder¹, Stephan Krapick¹, Regina Kruse¹, Harald Herrmann¹, Tim J. Bartley¹, Christine Silberhorn¹; ¹Universität Paderborn, Germany. The present waveguide technology for quantum source fabrication is at an early stage of development. Here we present novel approaches to source engineering which enable us to generate specific multipartite and large size quantum states.



Branko Glišić received his degrees in Civil Engineering and Theoretical Mathematics at University of Belgrade, Serbia, and Ph.D. at the EPFL, Switzerland. After eight-year long experience at SMARTEC SA, Switzerland, he moved to Princeton University, where he holds position of Associate Professor at the Department of Civil and Environmental Engineering. His main areas of interest are Structural Health Monitoring (SHM), advanced sensors based on fiberoptics, large-area electronics and conductive polymers, SHM data management and analysis, smart structures, and heritage structures. He is author and co-author of numerous papers, short courses, and the book "Fibre Optic Methods for Structural Health Monitoring.

Thursday, 22 October

Glen Ellen	Sacramento	Hillsborough	Piedmont
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	07:30–17:30 Registrat	ion, Market Street Foyer	
08:00–10:00 FTh1F • Computational Optical Sensing and Imaging I Presider: Michael Gehm; Duke Univ., USA	08:00–10:00 FTh1G • Optics and Photonics of Disordered Systems I Presider: Massimo Gurioli; Universita degli Studi di Firenze, Italy	08:00–10:00 LTh1H • Complex Wave Propagation <i>Presider: Shu Jia; SUNY Stony Brook, USA</i>	08:00–10:00 LTh1I • Innovative Metallic-Emitter Coupled Systems I Presider: Joshua Hendrickson; US Air Force Research Lab, USA
FTh1F.1 • 08:00 Invited WiO High Resolution 3D Computational Imaging in Scattering Media, Laura Waller'; 'Univ. of California Berkeley, USA. We describe new methods for high-resolution 3D imag- ng with illumination and detection-side coding of angle Fourier) space with fast acquisition times. The result is a high-resolution gigapixel image in multiple depth planes with fast capture times.	FTh1G.1 • 08:00 Invited Using Disorder to Create New Nanophotonic Function- ality, Mark Brongersma ¹ ; Istanford Univ., USA. Complex aperiodic devices can outperform periodic ones and offer new functionalities. In this presentation, I will describe the realization and optical properties of ultra-compact, aperiodic groove-arrays in a metal film.	LTh1H.1 • 08:00 Invited Surface Gravity Water Wave Airy Wavepacket, Shenhe Fu ^{1,2} , Yuval Tsur ¹ , Jianying Zhou ² , Lev Shemer ¹ , Ady Arie ¹ ; ¹ Tel-Aviv Univ., Israel; ² Sun Yat-sen Univ., China. We study the propagation dynamics of surface gravity water wave Airy pulses in the linear and nonlinear regimes. The low carrier frequency enables observing the position-dependent phase of the Airy pulse for the first time.	LTh11.1 • 08:00 Invited Nanoscale Probing of Surface Plasmons with Single Quan- tum Dots, Edo Waks ¹ , Chad Ropp ¹ , Roland Probst ¹ , Zacharee Cummins ¹ , Sanghee Nah ¹ , John Fourkas ¹ , Benjamin Shapiro ¹ ; ¹ Unix. of Maryland at College Park, USA. We demonstrate a method to probe the local density of states of surface plasmon polaritons using single quantum dots. We attain better than 10 nm spatial precision, and directly observe image dipole interference.
-Th1F.2 • 08:30	FTh1G.2 • 08:30	LTh1H.2 • 08:30	LTh11.2 • 08:30 Invited WiO

An Implementation of One-Shot Compressive Imaging Using a Diffractive Optical Element, Alexander Macfaden¹, Stephen J. Kindness¹, Timothy D. Wilkinson¹; ¹Univ. of Cambridge, UK. We propose and demonstrate a new implementation of compressive imaging using a diffractive optical element. This method utilises a static hologram to produces a spot array from which the original image can be recovered.

Glan Ellan

Lattice Topology Dictates Photon Statistics in One-Dimensional Disordered Lattices, Hasan E. Kondakci¹, Avman Abouraddy¹, Bahaa Saleh¹: ¹CREOL, Univ. of Central Florida, USA. We examine propagation of coherent light in one-dimensional disordered photonic lattices with non-trivial topological structures. We show that the field statistics becomes noncircular in the phase plane only in even-sited-ring and linear lattices with off-diagonal disorder.

Sacramento

Optical Vortex Behavior due to Introduced Phase Disturbance, Mateusz Szatkowski¹, Agnieszka Popiolek-Masajada¹, Jan Masajada¹; ¹Dept. of Optics and Photonics, Wroclaw Univ. of Technology, Poland. Presented work is the next step into creating effective procedure for surface topography reconstruction from Optical Vortex Scanning Microscope data. It focuses on optical vortex behavior due to object introduced by Spatial Light Modulator.

Hillsborough



Strongly Enhanced Light-Matter Interactions using Colloidally Synthesized Plasmonic Nanocavities, Maiken H. Mikkelsen¹; ¹Duke Univ., USA. A colloidally synthesized and tunable plasmonic platform is utilized for control of radiative properties of dye molecules, CdSe/ZnS quantum dots, and monolayer MoS₂. We demonstrate 30,000-fold fluorescence enhancement, Purcell factors of 1,000, and ultrafast spontaneous emission.

Piedmont

California	Valley	Crystal	Gold	Empire
FiO				
FTh1A • General Optical Sciences III—Continued	FTh1B • Light Manipulation in Plasmonic Structures—Continued	FTh1C • Coherence, Interference and General Optics I—Continued	FTh1D • Integrated Quantum Optics II—Continued	FTh1E • Optical Fiber Sensors I: Applications—Continued
FTh1A.4 • 08:45 WIO Aspect-Ratio-Tailored Silver Nanoplates for Efficient Broad- and Tunable-Bandwidth Extinction in the Visible Range, Emma An- quillare ¹ , Owen D. Miller ¹ , Chia Wei Hsu ^{1,2} , Brendan G. DeLacy ³ , John Joannopoulos ¹ , Steven Johnson ¹ , Marin Soljacic ¹ ; 'MIT, USA; ² Physics, Harvard Univ., USA; ³ Edgewood Chemical Biological Center, US Army, USA. We computationally predict and experimentally demonstrate that aspect-ratio-tailored silver nanoplates excel at volume-minimized, visible- range extinction. Normalized extinction (o _{ent} /V) closely approaches or meets theory limits in three windows and is a six-fold increase over previous experiments.	FTh1B.3 • 08:45 C Arbitrary Spectral Shaping of Plasmonic Broadband Excitations, Yuval Tsur ¹ , Itai Ep- stein ¹ , Ady Arie ¹ ; <i>Tel Aviv Univ., Israel.</i> Surface plasmon polaritons having an arbitrary broad- band spectrum are launched using holographic gratings, allowing unprecedented control over the temporal shape. Among the potential ap- plications are broadband sensors and ultrashort pulse shaping.	FTh1C.3 • 08:45 C A Coulomb-like Potential for Optical Vortices, Anderson M. Amaral', Edilson L. Falcao-Filho', Cid B. de Araujo'; 'Universidade Federal de Pernambuco, Brazil. Optical Vortices (OV) can be characterized by their Topological Charge (TC). It is shown in this work that a distribution of TC over the beam transverse plane gives rise to a Coulomb-like potential for OV. Pure multipoles and 2D distributions of TC are analyzed in theory and experiments.		FTh1E.2 • 08:45 Fiber Optic Gas Monitoring System for Coa Mine Safety, Amiya R. Behera ¹ , Bo Dong ¹ , Anb Wang ¹ ; ¹ Virginia Tech, USA. A multiple gas mon toring system based on wavelength modulatio spectroscopy has been designed and fabricate for atmospheric monitoring inside coal mines The sensor system is evaluated for Methan- detection from 0.01% to 50% concentration.
FTh1A.5 • 09:00 Arbitrary designable optical frequency con- version, Jian Zheng', Masayuki Katsuragawa ^{1,2} ; 'Unix. of Electro-Communications, Japan; ² JST ERATO-IOS, Japan. We discuss arbitrarily- designable optical frequency conversions. As a typical example, we demonstrate the single frequency tunable laser that covers an ultra- broad spectral region from vacuum-ultraviolet to mid-infrared in a numerical experiment.	FTh1B.4 • 09:00 C Quadrupole Field in Plasmonic Crystal, Kyosuke Sakai', Takeaki Yamamoto', Tatsuya Omura', Keiji Sasaki'; 'Hokkaido Univ., Japan. We theoretically propose plasmonic crystal with nanoring that supports quadrupole electric field inside of the ring. If such field distributions coincide with the wave function of molecules, multipole transitions might be provoked with higher rate.	FTh1C.4 • 09:00 WiO Three-dimensional Transfer-function of an Inhomogeneously Broadened Atomic Medium for All Optical Spatio-Temporal Video Clip Orrelation, Mehjabin Sultana Monjur ¹ , Selim Shahriar ¹ ; 'Northwestern Univ., USA. We show that an opto-atomic spatio-temporal correlator that recognizes rapidly a video clip contained in a video file in a temporally and spatially shift invariant manner can be modeled as a one-term, three-dimensional transfer function.	FTh1D.3 • 09:00 WiO Integrated AlGaAs Source of Highly Indis- tinguishable and Energy-Time Entangled Photons, Claire Autebert ¹ , Natalia Bruno ² , Anthony Martin ² , Aristide Lemaitre ³ , Carmen Gomez ³ , Ivan Favero ¹ , Guiseppe Leo ¹ , Sara Ducci ¹ , Hugo Zbinden ² ; 'Lab MPQ, France; ² Group of Applied Physics, Switzerland; ³ Lab LPN, France. We demonstrate an AlGaAs source of highly indistinguishable and energy-time entangled photon pairs. The device is charac- tetized through Hong-Ou-Mandel and a Franson interferometry experiments displaying visibilities of 89+/-3% and 95.6 +/-3.7%, respectively.	FTh1E.3 • 09:00 Solar Tracker Sensor Based on a Quadram Optical Fiber Array, Diego J. Rátiva Millán' Denise Valente ² , Luis Arturo G. Malagón ¹ , Briar Vohnsen ² ; ¹ Universidade de Pernambuco, Brazi ² School of Physics, Univ. College Dublin, Irelanc Exploring the directionality of light coupling te a waveguide, a quadrant of Ytterbium-Dopee Fibers is proposed and analyzed for solar track ing systems.
FTh1A.6 • 09:15 EM Wave Propagation in a Medium with Anisotropic Dielectric and Magnetic Tensors, Boris Y. Zeldovich ¹ , Nadia Baranova ² ; ¹ Univ. of Central Florida, CREOL, USA; ² Q-Peak, Inc., USA. Dependence of phase velocity on propagation direction is shown to be decoupled from birefringence. The latter is propagation	FTh1B.5 • 09:15 Antenna Coupled Plasmonic Modulator, Yannick Salamin ¹ , Romain Bonjour ¹ , Wolfgang Heni ¹ , Christian Haffner ¹ , Claudia Hoessbacher ¹ , Yuriy Fedoryshyn ¹ , Marco Zahner ¹ , Delwin Elder ² , Larry Dalton ² , Christian Hafner ¹ , Juerg Leuthold ¹ ; ¹ ETH Zurich, Switzerland; ² Univ. of Washington, USA. We demonstrate direct	FTh1C.5 • 09:15 Light Interference in Position and Momentum Variables: the Spatial Alford and Gold Effect, Jefferson Florez ¹ , Omar Calderon-Losada ¹ , Luis- Jose Salazar-Serrano ^{1,2} , Juan-Rafael Alvarez- Velasquez ¹ , Alejandra Valencia ¹ , ¹ Universidad de los Andes, Colombia; ² ICFO-Institut de Ciencies Fotoniques, Spain. Intensity modulation of two	FTh1D.4 • 09:15 WiO Low-noise Quantum Frequency Conversion in Titanium- diffused Lithium Niobate wave- guide, Abu Thomas ¹ , Mackenzie A. VanCamp ¹ , Andrew Fraine ¹ , Alexander V. Sergienko ¹ ; ¹ Bos- ton Univ., USA. We demonstrate single-photon level Quantum Frequency Conversion using guasi-phase matched Ti:LiNbO, waveguides.	FTh1E.4 • 09:15 The Dual-Polarization Interferometric Fibe Optic Gyroscope: an Optical Compensatio Approach, Rongya Luo ¹ , Zinan Wang ¹ , Fangyu an Chen ¹ , Chao Peng ¹ , Zhengbin Li ¹ ; ¹ Stat Key Lab of Advanced Optical Communicatio Systems and Networks, Dept. of Electronic: Peking Univ., China. By utilizing a Lyot depola

parallel-propagating beams is observed in the

Fourier plane when the beams' separation

is such that they do not interfere in position.

This is analogous to the temporal Alford and

Gold effect.

The potential of such devices for higher di-

mensional encoding using temporal qdits and

quantum optical arbitrary waveform generation

is discussed.

izer as a polarization filter, the dual-polarization

interferometric fiber optic gyroscope realizes

optical compensation in both reciprocal and

nonreciprocal ports. A configuration in polar-

ization maintaining sensing coil is proposed.

up-conversion of a 60 GHz RF carrier onto an

optical signal. The plasmonic modulator is seam-

lessly embedded in the RF receiving antenna.

Therefore, neither electronic down-conversion

nor electronic amplification is needed.

of mu / epsilon.

difference for two polarizations; it depends on

anisotropy of impedance tensor: square root

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FTh1F • Computational Optical Sensing and Imaging I—Continued	FTh1G • Optics and Photonics of Disordered Systems I—Continued	LTh1H • Complex Wave Propagation— Continued	LTh1I • Inn Systems I–

FTh1F.3 • 08:45

Multispectral single-channel 3D computational integral imaging using compressive sensing, Inbarasan Muniraj¹, Sudharsan Rajasekaran¹, Changliang Guo¹, John T. Sheridan¹; ¹Univ. College Dublin, Ireland. We propose a simplest way of capturing multispectral 2D elemental images (Els) in the computational integral imaging using compressive sensing (CS). Simulations show that the performance of 3D systems remains superior even when Els are recovered from the sparse samples.

FTh1G.3 • 08:45

Double threshold behavior in a resonance-controlled ZnO random laser, Ryo Niyuki', Hideki Fujiwara', Toshihiro Nakamura', Yoshie Ishikawa'', Naoto Koshizaki', Takeshi Tsuji', Keiji Sasaki'; 'Hokkaido Univ, Japan; 'Cumma Univ, Japan; 'JAIST, Japan; 'Shimane Univ, Japan. We observed double threshold behavior with the lasing peak blue-shift in a resonance-controlled ZnO random laser. The present study suggested the possibility for realizing strong coupling of excitons and single localized modes in random structures. LTh1H.3 • 08:45 High-Power Contin

High-Power, Continuous-wave, Source Of Coherent Radiation In 2-D Airy Intensity Distribution, Aadhi A^{1,2}, Apurv Chaitanya N^{1,2}, Jabir M V¹, Pravin Vaity¹, R. P. Singh¹, Goutam Samanta¹; *Physical Research Lab, India; ²Indian Inst.* of Technology Gandhinagar, India. We demonstrate a new class of tunable Airy beam source based on OPO, producing high-power, continuous-wave, single-frequency Airy beam radiation. The source provides total tunability of 460nm and maximum of 8.1W in 2D-Airy beam structure.

LTh11 • Innovative Metallic-Emitter Coupled Systems I—Continued

FTh1F.4 • 09:00

Lateral Chromatic Aberration Optimization in Wide-Fieldof-View Computational Cameras, Furkan E. Sahin¹, Patrick J. Nasiatka¹, Armand R. Tanguay¹; ¹Univ. of Southern California, USA. An imaging system design procedure for miniature wide-field-of-view computational cameras is presented. Improved performance can be achieved by allowing lateral chromatic aberration in the optical design, with correction provided in computational post-processing.

FTh1G.4 • 09:00

Control of Transmission Eigenchannels by Modifying the Geometry of Turbid Media, Raktim Sarma¹, Alexey Yamilov², Hui Cao¹; ¹Yale Univ., USA; ²Missouri Univ. of Science & Technology, USA. We manipulate light transport in a disordered waveguide by tailoring the boundary shape. The spatial structure of transmission channels is deterministically and significantly modified, enabling an efficient control of energy deposition inside the turbid medium.

LTh1H.4 • 09:00

Talbot coupling of laser arrays in a degenerate cavity, Ronen Chriki¹, Vishwa Pal¹, Chene Tradonsky¹, Gilad Barach¹, Asher A. Friesem¹, Nir Davidson¹; ¹Weizmann Inst. of Science, Israel. Talbot diffraction coupling is exploited for controlling phase locking and demonstrating topological charge effects in laser arrays formed in a degenerate cavity. Experimental and calculated results for different array geometries are demonstrated.

LTh11.3 • 09:00 Invited

Enhancement of Two-Photon Luminescence from Quantum Emitters: Metamaterial-Enabled Chiral Selectivity, Sean Rodrigues', Yonghao Cui'l, Shoufeng Lan', Lei Kang', Wenshan Cai'; 'Georgia Inst. of Technology, USA. We present a chiral metamaterial that exhibits both distinguishable linear and nonlinear features. The chiral center of the metamaterial is opened for direct access, where emitters occupying the light-confining regions produce chiral-selective enhancement of two-photon luminescence.

FTh1F.5 • 09:15

Structured Illumination Temporal Compressive Microscopy, Shuo Pang¹, Xin Yuan²; ¹Univ. of Central Florida, CREOL, USA; ²Bell Labs, USA. We present a compressive video microscope based on structured illumination with incoherent light source. The setup can be easily adapted in a conventional epiillumination microscope. We demonstrate a reconstructed video with frame rate of 200 frames per second.

FTh1G.5 • 09:15

Extreme value statistics of intensity fluctuations in random lasers, Ravitej Uppu¹, Sushil A. Mujumdar¹; ¹Tata Inst. of *Fundamental Research, India.* We report a first study on the extreme value statistics of intensity in random lasers. The estimated extreme value index identified a forward transition from near-Gumbel to Frechet distribution, followed by the return.

LTh1H.5 • 09:15 Invited

Momentum Space Dynamics of Electrons at Hybrid Interfaces, Benjamin Stadtmüller¹; ¹Technische Universität Kaiserslautern, Germany. In this presentation, we will demonstrate how quasi-elastic electron lifetimes and momentum space dynamics of excited electrons at metal-organic hybrid interfaces can be studied by the combination of two-photon photoemission and momentum microscopy.

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FTh1A • General Optical Sciences III—Continued	FTh1B • Light Manipulation in Plasmonic Structures—Continued	FTh1C • Coherence, Interference and General Optics I—Continued	FTh1D • Integrated Quantum Optics II—Continued	FTh1E • Optical Fiber Sensors I: Applications—Continued
ETh1A.7 • 09:30 Radiation Pressure Measurement under Ambi- ent Conditions Using a Microcantilever , Da- kang Ma ^{1,2} , Joseph Garrett ^{2,3} , Jeremy Munday ^{1,2} ; Dept. of Electrical and Computer Engineering, Univ. of Maryland, USA; ² Inst. for Research in Electronics and Applied Physics, Univ. of Mary- and, USA; ³ Dept. of Physics, Univ. of Mary- land, USA; ³ Dept. of Physics, Univ. of Mary- land, USA; ³ Dept. of Physics, Univ. of Mary- and, USA; ⁴ Dept. of Physics, Univ. of Mary- and, Univ. of Mary- and, USA; ⁴ Dept. of Physics, Univ. of Physics, Univ. of Mary- and, USA; ⁴ Dept. of Physics, Univ. of Mary- and, USA; ⁴ Dept. of Physics, Univ. of Mary- and, USA; ⁴ Dept. of Physics, Univ. of Mary- a	FTh1B.6 • 09:30 C Cavity Effect of a Dielectric Layer on Nanograting Structures, Chao Niu ¹ , Tiffany Huang ¹ , Xin Zhang ² , Haitao Liu ² , Weihua Zhang ³ , Jonathan Hu ¹ ; ¹ Baylor Univ., USA; ² Nankai Univ., China; ³ Nanjing Univ., China. We study the cavity effect of a dielectric layer on nanograt- ing structures. Varying the thickness of the thin dielectric layer causes the waves in the cavity to oscillate between constructive and destruc- tive interference.	FTh1C.6 • 09:30 Withdrawn.	FTh1D.5 • 09:30 D Bell State Generation and Pump Filtering Us- ing Inhomogeneously Poled Nonlinear Wave- guides, James Titchener ¹ , Alexander Solntsev ¹ , Andrey Sukhorukov ¹ ; ¹ ANU, Australia. We show that special domain poling patterns in arrays of coupled nonlinear waveguides can allow shap- ing of the photon pair wavefunction produced by down-conversion. This allows pump filtering and the reconfigurable generation of Bell states.	FTh1E.5 • 09:30 WiO Lossy Mode Resonance Based Fiber Opti Chlorine Gas Sensor Using Zinc Oxid Nanoparticles, Sruthi P. Usha', Satyendra K Mishra', Banshi D. Gupta'; 'Indian Inst. of Tech nology, Delhi, India. We report the fabricatio and characterization of a fiber optic chlorin gas sensor using lossy mode resonance (LMF and ZnO nanoparticles. A peak shift of 14 nr with increasing concentration of chlorine ga is observed.
FTh1A.8 • 09:45 Reduced Reflection of Light in Random Am- bifying Media, Seng Fatt Liew ¹ , Hui Cao ¹ ; ¹ Ap- blied Physics, Yale Univ., USA. We investigate he effect of light amplification on the minimum eflection channel in a random medium. En- nanced destructive interference of the excited esonant modes may cause a reduction in the minimum reflection with increasing gain.	FTh1B.7 • 09:45	FTh1C.7 • 09:45 High efficiency holographic optical traps for cold atoms, Sebastien Tempone-Wiltshire', Shaun P. Johnstone', Phillip T. Starkey', Kristian P. Helmerson'; 'Monash Univ., Australia. We present a simple method of creating high quality holographic optical elements(HOEs) for cold atom trapping. This is achieved by exposing a photopolymer to an optical field tailored by a phase only spatial light modulator.	FTh1D.6 • 09:45 Entanglement distribution between inte- grated silicon photonic chips, Jianwei Wang ¹ , Damien Bonneau ¹ , Matteo Villa ^{1,2} , Joshua Silver- stone ¹ , Raffaele Santagati ¹ , Shigehito Miki ³ , Taro Yamashita ³ , Mikio Fujiwara ⁴ , Masahide Sasaki ⁴ , Hirotaka Terai ⁴ , Michael G. Tanner ⁵ , Chandra M. Natarajan ⁵ , Robert H. Hadfield ⁵ , Jeremy L. O'Brien ¹ , Mark G. Thompson ¹ ; 'Centre for Quantum Photonics, H. H. Wills Physics Lab & Dept. of Electrical and Electronic Engineer- ing, Univ. of Bristol, UK; ² Istituto di Fotonica e Nantecnologie, Dipart di Fisica-Politecnico di Milano, Italy; ³ National Inst. of Information and Communications Technology (NICT), Japan; ⁶ School of	FThE.6 • 09:45 WiO Electro-optic V-band Power Sensing System Du-Ri Song ¹ , Seok Kim ¹ , Jae-Young Kwon ¹ Dong-Joon Lee ¹ ; 'Korea Research Inst. of Stan dards and Science(KRISS), Korea. We present an electro-optic sensing system for power and electric field measurements based on a photonic heterodyne scheme in the V-band. This system realizes endoscopic detection of fully guided travelling-electric fields within the waveguide.
Fo	Join the conversation. ollow @Opticalsociety on T Use hashtag #Fi015	witter.	Engineering, Univ. of Glasgow, UK. We demon- strate high-fidelity distribution of entanglement across two integrated silicon photonic chips, by observing a violation of a Bell-type inequality of 2.638±0.039. Entanglement states are gener- ated and measured on-chip, and coherently distributed between chips.	
	10:00-10:30	Coffee Break, Market Street & South	Tower Fovers	

Thursday, 22 October

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FTh1F • Computational Optical Sensing and Imaging I—Continued	FTh1G • Optics and Photonics of Disordered Systems I—Continued	LTh1H • Complex Wave Propagation— Continued	LTh11 • Innovative Metallic-Emitter Coupled Systems I—Continued
FTh1F.6 • 09:30 Compressive Sensing For Digital In-line Holographic Microscopy, Prakash Ramachandran ¹ , Praveen Phinehas ¹ , Zachariah Alex ¹ , Anith Nelleri ¹ ; 'Vellore Inst. of Technology, India. Compressive sensing is applied for Digital in-line Ho- lographic Microscopy assuming the object wave is sparse in spatial domain. The reconstructed complex image is free of noise when compared to conventional method of numerical reconstruction.	FTh1G.6 • 09:30 Single Photon Quantum Walk in Waveguide Arrays with Next-nearest Neighbor Interaction, Surajit Paul ¹ , Krishna Thyagarajan ¹ ; 'Indian Inst. of Technology, Delhi, India. We show how the next nearest neighbor interaction modifies the photon propagation characteristics in 1-D waveguide arrays and how this enables us to realize a 5 partite W state in an array of 5 equally spaced waveguides.		LTh11.4 • 09:30 Invited Flat Nonlinear Optics: Efficient Frequency Conversion in Ultrathin Nonlinear Metasurfaces, Mikhail A. Belkin ¹ ; 'Univ. of Texas at Austin, USA. We report highly-nonlinear ultrathin metasurfaces based on coupling of modes in plasmonic nanoresonators with intersubband nonlinearities with phase- control of nonlinear optical response. Nonlinear susceptibility >10 ⁶ pm/V and conversion efficiency ~0.1% were measured for second-harmonic generation.

FTh1F.7 • 09:45

Image Fusion of Color Microscopic Images for Extended the Depth of Field, Roman Hurtado Perez¹, Carina Toxqui-Quitl¹, Alfonso Padilla-Vivanco¹; ¹ Universidad Politecnica De Tulancingo, Mexico. In optical microscopy, the depth of field (DOF) is limited by the physical characteristics of the image forming systems. In order to extend the DOF of a microscopic system, this paper a method of image fusion and multi-pronged approach based module gradient color planes is proposed.

FTh1G.7 • 09:45 WiO

Evanescent-Vacuum-Induced Coupling Coefficient Enhancement in Nanocavity, Juanjuan Ren¹, Ying Gu^{1,2}, Hang Lian¹, Fan Zhang¹, Dongxing Zhao¹, Tiancai Zhang³, Qihuang Gong^{1,2}, 'State Key Lab for Mesoscopic Physics, Dept. of Physics, Peking Univ., China; ²Collaborative Innovation Center of Quantum Matter, China; ²State Key Lab of Quantum Optics and Quantum Optics Devices, Inst. of Opto-Electronics, Shanxi Univ., China. We theoretically demonstrate the coupling coefficient enhancement and nanoscale guiding of emitted photons in cavity quantum electrodynamics system consisting of a single emitter and a Ag nanorod in evanescent vacuum provided by a single-mode nanofiber.

LTh1H.6 • 09:45 WiO

Near-Field Intensity Fluctuations: the Role of Disorder Correlations, Roxana Rezvani Naraghi^{1,2}, Sergey Sukhov¹, Aristide Dogariu¹; ¹1CREOL, The College of Optics and Photonics, Univ. of Central Florida, USA; ²Dept. of Physics, Univ. of Central Florida, USA. Near-field measurements on mesoscopic, strongly scattering media and systematic numerical calculations are used to establish the dependence between intensity distributions and the statistical homogeneity of random structures with controlled disorder.

10:00–10:30 Coffee Break, Market Street & South Tower Foyers

California	Valley	Crystal	Gold	Empire
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10:30–12:00 FTh2A • General Optical Sciences IV Presider: Laszlo Veisz, Max- Planck-Institute fur Quantenoptik, Germany	10:30–12:00 FTh2B • Photonics on Silicon Presider: John Dallesasse; Univ of Illinois at Urbana-Champaign, USA	10:45–12:00 FTh2C • Coherence, Interference, and General Optics II Presider: Stephen Kuebler, Univ. of Central Florida, USA	10:30–12:00 FTh2D • Quantum Communications I Presider: Wolfgang Tittel; Univ. of Calgary, Canada	10:30–12:00 FTh2E • Optical Fiber Sensors II: Biosensors D Presider: David Hill; OptaSense, UK
FTh2A.1 • 10:30 Phase Transformations Upon Generalised Refraction, Simon Horsley ² , Thomas Philbin ² , Johannes K. Courtial ¹ ; ¹ Univ. of Glasgow, UK; ² Dept. of Physics and Astronomy, Univ. of Ex- eter, UK. Many generalised laws of refraction would transform incident light-ray fields into wave-optically forbidden fields. We investigate the transformation of those light-ray fields that can be transformed.	FTh2B.1 • 10:30 C Cross Nonlinear Absorption in Silicon Wave- guides, Young Zhang ¹ , Chad Husko ^{2.1} , Simon Lefrancois ¹ , Isabella H. Rey, ⁴ , Thomas Krauss ⁴ , Jochen Schroeder ³ , Benjamin Eggleton ¹ ; ¹ Univ. of Sydney, Australia; ² Center for Nanoscale Materials, Argonne National Lab, USA; ³ School of Electrical and Computer Engineering, RMIT, Australia; ⁴ Dept. of Physics, Univ. of York, UK. We investigated cross nonlinear absorption in silicon waveguides using the probe-pump scheme. An analytic solution of the probe is derived including XTPA. We experimentally extracted the effect of each loss on powers using a simple method.	FTh2C.1 • 10:30 Withdrawn.	FTh2D.1 • 10:30 Invited WiO Distributing Secret Keys using Quantum Continuous Variables, Eleni Diamanti ^{2,1} ; <i>'Telecom-Paristech, France;</i> ² CNRS, France. We provide an overview of the state-of-the-art in continuous-variable quantum key distribu- tion, including long-distance experiments and the analysis of the practical security of such implementations. We also discuss exciting perspectives in the field.	FTh2E.1 • 10:30 Invited High-performance Label-free Biosensing by Long Period Gratings, Francesco Baldini', Francesco Chiavaioli', Ambra Giannetti', Sara Tombelli', Cosimo Trono'; 'Ist di Fisica Applicata Nello Carrara, Italy. Long period fiber gratings (LPGs) have been proposed as label-free biosen- sors since a few years. LPGs are an emergent, expanding and alternative option for measuring refractive index changes with respect to other label-free optical platforms.
FTh2A.2 • 10:45 WiO Localized Parity-Time Symmetric Directionally Invisible Scatterers and Cloaks, Elisa Hurwitz ¹ , Greg Gbur ¹ ; ¹ UNC Charlotte, USA. A technique for designing localized parity-time (PT) symmet- ric directionally invisible scatterers and cloaks is introduced and verified by numerical scattering simulations. Implications and generalizations of the method are discussed.	FTh2B.2 • 10:45 Invited Silicon Photonics Beyond the Silicon-on- Insulator Platform, Sasan Fathpour ¹ ; ¹ Univ. of <i>Central Florida, CREOL, USA.</i> The silicon-on- insulator platform has several shortcomings for near- and mid-infrared integrated photonics. Heterogeneous platforms that integrate silicon with lithium niobate, tantalum pentoxide, chal- cogenide glass and silicon nitride, as well as all-silicon waveguides are reviewed.	FTh2C.2 • 10:45 C Chirped Bragg Grating for Beam Combining and Moiré Spectral Filtering, Boris Y. Zeldov- ich', Sergiy Kaim', Vadim Smirnov ² , Leonid Glebov ^{1,2} , 'Unix. of Central Florida, CREOL, USA; ² OptiGrate Corp , USA. Chirped Bragg Grating (CBG) at tilted incidence is shown producing wavelength-dependent transverse beam stretching allowing for spectroscopy and spectral beam combining. Moiré patterned CBG at normal incidence is shown producing spectral comb filter.		
FTh2A.3 • 11:00 WiO Superluminescent Diode Coupled with Etalon for Measuring CH ₄ and CO ₂ in Biogas, Ramya Selvaraj ¹ , Sulochana K ¹ , Nilesh J. Vasa ¹ , Shiva Nagendra S M ¹ ; 'Indian Inst. of Technology Madras, India. Superluminescent diode based absorption spectroscopy is demonstrated for simultaneous measurement of CH ₄ and CO ₂ in biogas. A free space etalon is used to avoid interference from other gases and allow mea- surement with a low resolution spectrometer.		FTh2C.3 • 11:00 Beam Reflection by Transversely Chirped Volume Bragg Grating, Sergiy Mokhov ¹ , Ivan Divliansky ¹ , Leonid Glebov ¹ , Boris Y. Zeldovich ¹ ; ¹ Univ. of Central Florida, CREOL, USA. Trans- versely chirped volume Bragg grating (TCVBG) provides tunability of resonant wavelength in different designs of laser cavities. Resonant reflectivity suppression and quality deterioration of Gaussian beam reflected by TCVBG are cal- culated, together with spectral characteristics.	FTh2D.2 • 111:00 Invited C Recent Activities on Space Laser Communica- tions in Japan and First In-Orbit Verification for Micro-Satellites, Morio Toyoshima'; 'Space Communication Systems Lab, National Inst. of Information and Communication Technology, Japan. Recent activities on space laser commu- nications in Japan are presented which include the world first in-orbit verification of space laser communications onboard micro-satellites and the future plan to conduct the basic satellite QKD experiments.	FTh2E.2 • 111:00 In Vivo Pressure and Temperature Monitoring during Near Infrared Photo-Immunotherapy Using a Fiber Optic Sensor, Zhijian Zhang ¹ , Hyungdae Bae ¹ , Tadanobu Nagaya ² , Yuko Na- kamura ² , Peter Choyke ² , Hisataka Kobayashi ² , Miao Yu ¹ ; ¹ Dept. of Mechanical Engineering, Univ. of Maryland, USA; ¹ National Inst.s of Health, USA. We designed a fiber optic sensor with dual Fabry–Pérot cavities and demon- strated its real-time monitoring capability of pressure and temperature during a photo- immunotherapy process.

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10:30–12:00 FTh2F • High Power Raman Fiber Lasers Presider: Roger Stolen; Clemson Univ., USA

FTh2F.1 • 10:30 Invited

High Power Raman Fiber Lasers: Recent Progress, Yan Feng¹; ¹Shanghai Inst of Optics & Fine Mechanics, China. Raman fiber lasers are known for wavelength agility. Recently, both spectral coverage and output power have progressed quickly, which expands the field of application of Raman fiber laser significantly. 10:30–12:00 FTh2G • Optics and Photonics of Disordered Systems II Presider: Mark Brongersma; Stanford Univ., USA

FTh2G.1 • 10:30 Invited

Engeeniering and Imaging Random Photonic Modes, Massimo Gurioli'; 'Universita degli Studi di Firenze, Italy. We demonstrate experimentally the ability to fully control and maps the spectral properties of an individual photonic mode in a two-dimensional disordered photonic GaAs slab with disordered distributions of circular air holes. 10:30–11:30 LTh2H • Light propagation in Scattering Media Presider: Jeffrey Field, Colorado State Univ., USA

LTh2H.1 • 10:30 Invited WiO

Coherent Control of Light Transmission and Absorption in Random Scattering Media, Hui Cao¹; ¹Yale Univ., USA. We used wavefront shaping to enhance/suppress the transmission of coherent light through open highly scattering media. We further controlled the short-circuit current of a dyesensitized solar cell by shaping the wavefront of a laser beam.

LS

10:30–12:00 LTh2I • Innovative Metallic-Emitter Coupled Systems II Precider: Edo Weks: Univ. of Mandand at

Presider: Edo Waks; Univ. of Maryland at College Park, USA

LTh2I.1 • 10:30 Invited

Topological Edge States of Photons, Plasmons and Photon Pairs in Nanostructures, Alexander N. Poddubny^{1,2}; ¹/offe Inst., Russia; ²ITMO Univ., Russia. We will present latest experimental results for classical edge states of photons and plasmonic particles and discuss the quantum edge states of photon pairs.

FTh2F.2 • 11:00

Raman enhanced acoustically tailored single-frequency Raman fiber amplifiers, lyad Dajani¹, Christopher L. Vergien², Jean-Claude Diels²; ¹Directed Energy Directorate, Air Force Research Lab, USA; ²Physics and Astronomy, Univ. of New Mexico, USA. Acoustically tailored fiber was developed to mitigate stimulated Brillouin scattering (SBS) in singlefrequency 1178 nm fiber based amplifiers, while enhancing Raman gain by 30%. We demonstrate single and two-stage amplifiers with 11.2 W and 22.2 W of output power.

FTh2G.2 • 11:00

Deterministic Control of Photon Statistics by Activation of Chiral Symmetry in Disordered Lattices, Hasan E. Kondakci², Armando P. Leija¹, Alexander Szameit¹, Ayman Abouraddy², Demetrios N. Christodoulides², Bahaa Saleh²; *1Inst. of Applied Physics, Friedrich-Schiller-Universität Jena, Germany;* ²CREOL, Univ. of Central Florida, USA. We experimentally demonstrate deterministic tuning of photon statistics from sub-thermal to super-thermal in off-diagonal disordered lattices. We achieve this by symmetrically exciting chiral-mode pairs with coherent light of different field distributions.

LTh2H.2 • 11:00

Polychromatic Transmission Eigenchannels of Scattering Media, Chia Wei Hsu¹, Arthur Goetschy², Yaron Bromberg¹, A. Douglas Stone¹, Hui Cao¹; ¹Yale Univ., USA; ²Université Paris-Diderot, France. We extend the concept of transmission eigenchannels to describe polychromatic light with a common wavefront. Due to the long-range spectral correlation of the media, significant enhancement of total transmission is possible even for broadband light.

LTh2I.2 • 11:00 Invited

Semiconductor-Superconductor Hybrid Devices, Evyatar Sabag', Raja Marjieh', Roni Winik ', Shlomi Bouscher', Nimrod Ginzberg ', Vicky Perepelook', Leonid Rybak', Alex Hayat'; 'Technion, Israel. We showed superconducting proximity in semiconductor light-emitting diodes proposed by us for enhanced two-photon gain and electrically-driven entangled-photon sources. We produced high-Tc superconductivity in topological insulators and demonstrated high-Tc superconductor-semiconductor tunnel diodes.

California	Valley	Crystal	Gold	Empire	
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FTh2A • General Optical Sciences IV—Continued	FTh2B • Photonics on Silicon— Continued	FTh2C • Coherence, Interference, and General Optics II—Continued	FTh2D • Quantum Communications I—Continued	FTh2E • Optical Fiber Sensors II: Biosensors—Continued	
FTh2A.4 • 11:15 Generalizing and extending Kubelka-Munk theory, Chris Sandoval ¹ , Arnold Kim ¹ ; ¹ Natu- ral Sciences, Applied Mathematics, Univ. of California, Merced, USA. Kubelka-Munk theory approximates the flow of power through a plane parallel slab of a scattering medium. We derive it from the radiative transfer equation and general- ze it to three dimensions for general boundary sources and non-homogeneous terms.	FTh2B.3 • 11:15 O Optimization of the Two-Layer Graphene Modulator on Silicon for High-Speed Op- eration, Goran Kovacevic ¹ , Shinji Yamashita ¹ ; 'Research Center for Advanced Science and Technology, Univ. of Tokyo, Japan. We imple- ment a self-developed numerical method to optimize the silicon waveguide dimensions of the modulator for high speed operation. Ad- ditionally, we propose a novel device structure which further increases the speed and reduces power consumption.	FTh2C.4 • 11:15 Partial Coherence Theory of Optical Phased Arrays, Edward A. Watson ^{1,2} ; 'Univ. of Dayton, USA; ² Vista Applied Optics, LLC, USA. We apply partial coherence theory formalism to describe the expected modulation transfer function asso- ciated with optical phased arrays with imperfect phasing. A particular example of a contiguous array with non-unity fill factor is considered.		FTh2E.3 • 11:15 Graphene-based D-shaped polymer FBC for highly sensitive erythrocyte detection Baicheng Yao', Yu Wu', David Webb ² , Jinhaa Zhou', Yunjiang Rao', Andrew Pospori ² , Caibin Yu', Yuan Gong', Yuanfu Chen'; 'UESTC, China ² Aston Univ., UK. By covering a monolayer of p doped graphene on a D-shaped microstructured FBG, a graphene based D-shaped polymer fibe Bragg grating is proposed to detect humar erythrocytes, with clinic acceptability and high sensitivity of sub ppm.	
FTh2A.5 • 11:30 Tungsten Nanoring Perfect Absorber for Solar Thermophotovoltaic System, Fengyun Zhao ¹ , Junfeng Qiao ¹ , Zhaoyu Zhang ¹ ; 'Peking Univ., China. Tungsten nanoring perfect absorber is studied numerically. The excitations of LSPR, SPPs and intrinsic bandgap absorption of rungsten result in broadband perfect absorp- cion from 0.6µm to1.8µm, with absorbance more than 95%.	FTh2B.4 • 11:30 Withdrawn.	FTh2C.5 • 11:30 C Arimuthal Multiple Beam Interference Effects with Combinations of Vortex Beams, Jeffrey A. Davis', Ignacio Moreno ² , Taylor Womble-Dahl', Don Cottrell'; 'San Diego State Univ., USA; ² Departamento de Ciencia de Materialesw, Universidad Miguel Hernandez, Spain. We experimentally create azimuthal multiple beam interference effects using vortex beams with different topological charges. Because the radii of the beams depend on charge, smaller charges are Fresnel diffracted to the plane of the higher charge.	FTh2D.3 • 11:30 C Towards Space-to-Ground SuperDense Tele- portation, Trent M. Graham ¹ , Chris Zeitler ¹ , Herbert J. Bernstein ² , Hamid Javadi ² , Paul G. Kwiat ¹ ; ¹ Dept. of Physics, Univ. of Illinois, USA; ² Jet Propulsion Lab, USA; ³ School of Natural Sci- ence & ISIS Inst. for Science and Interdisciplin- ary Studies, Hampshire College, USA. We use photons entangled in polarization and temporal mode to implement SuperDense Teleportation (SDT), a protocol for the transmission of states between remote parties. We are investigating the possibility implementing SDT between the International Space Station (ISS) and a receiver on Earth.	FTh2E.4 • 11:30 Invited Fiber Optic Acoustic Sensors for In-vivo Studies, Olav Solgaard'; 'Stanford Univ., USA. We present fiber optic Fabry-Perot acoustic sensors combine a small form factor with high sensitivity and enable recording of acoustic signals from individual cardiomyocytes.	
FTh2A.6 • 11:45 WiO Complete Analytic Solution to Vortex Beam Diffraction Through a Triangular Aperture, Charlotte Stahl', Greg Gbur'; 'Univ of North Carolina at Charlotte, USA. This paper lays but a rigorous analytical solution to on and off axis propagation for a vortex beam diffracting through a triangular aperture, with possible application in vortex-based communications.	FTh2B.5 • 11:45 Frequency conversion via asymmetrically pumped four-wave-mixing Bragg scattering in silicon waveguides, Yun Zhao ¹ , Andrew Sa- rangan ¹ , Imad Agha ^{1,2} ; 'Electro-Optics Graduate Program, Univ. of Dayton, USA; ² Dept. of Phys- ics, Univ. of Dayton, USA. We experimentally demonstrate low-power frequency conversion within the telecom C-band via asymmetrically- pumped Four-wave-mixing Bragg scattering in a chip-scale silicon-on-insulator waveguide. Numerical methods are used to predict device performance.	FTh2C.6 • 11:45 Restoring Sub-shot-noise Phase Sensitivity In a Realistic Two-photon Interferometry, Michal Jachura', Radoslaw Chrapkiewicz', Rafal Demkowicz-Dobrzanski', Wojciech Wasilewski', Konrad Banaszek'; 'Univ. of Warsaw, ul. Pas- teura 5, 02-093 , Poland. We demonstrate ex- perimentally that a careful design of the spatial structure of interfered photons, combined with position-resolved coincidence detection, allows to recover sub-shot-noise phase sensitivity in regime that otherwise cannot even attain the shot-noise limit.	FTh2D.4 • 11:45 C Implementation of Quantum and Classical Dis- crete Fractional Fourier Transforms, Armando P. Leija ¹ , Steffen Weimann ¹ , Maxime Lebugle ¹ , Markus Gräfe ¹ , René Heilmann ¹ , Stefan Nolte ¹ , Hector Moya-Cessa ² , Demetrios N. Christodou- lides ³ , Alexander Szameit ¹ ; ¹ Friedrich-Schiller- Universität Jena, Germany; ² Optics Dept., INAOE, Mexico; ³ CREOL, UCF, USA. We report on the experimental realization of quantum and classical discrete fractional Fourier transforms using photonic lattices. Our approach is fully integrated and free of bulk optical components.		
		12:00–13:00 Lunch (on your own)			

Thursday, 22 October

Glen Ellen	Sacramento	Hillsborough	Piedmont
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FTh2F • High Power Raman Fiber Lasers— Continued	FTh2G • Optics and Photonics of Disordered Systems II—Continued	LTh2H • Light propagation in Scattering Media—Continued	LTh2I • Innovative Metallic-Emitter Coupled Systems II—Continued
FTh2F.3 • 11:15 WiO Analysis of Modal Instability in Raman Fiber Amplifiers, Shadi A. Naderi ² , Iyad Dajani ¹ , Jacob Grosek ¹ , Timothy Mad- den ¹ ; ¹ US Air Force Research Lab, USA; ² Ball Aerospace & Technologies Corp., USA. It is well-known that the modal instability is a limiting factor in achieving high power in Yb- doped fiber amplifiers. We investigate this phenomenon theoretically in cladding-pumped and core-pumped Raman fiber amplifiers.	FTh2G.3 • 11:15 Controllable Diffusion in Time-varying Random Potentials, Colin Constant ¹ , Sergey Sukhov ¹ , Aristide Dogariu ¹ ; ¹ Univ. of Central Florida, CREOL, USA. Particles subjected to complex potentials that vary in both space and time can be sub- or super-diffusive. We demonstrate that their behavior can be controlled by adjusting the parameters of random optical potentials.	LTh2H.3 • 11:15 WIO Near-field Corrections in Mesoscopic Transport, Roxana Rezvani Naraghi ^{1,2} , Sergey Sukhov ¹ , Aristide Dogariu ¹ ; ¹ CRE- OL, The College of Optics and Photonics, Univ. of Central Florida, USA; ² Dept. of Physics, Univ. of Central Florida, USA, In dense composites, light transport evolves through both propagating and evanescent channels. A novel propagation model is developed in terms of measurable far- and near-field scattering. Its accuracy is verified by systematic enhanced backscattering experiments.	
FTh2F.4 • 11:30 Invited Trends in High Power Raman Fibre Lasers, Johan Nilsson ¹ ; ¹ Univ. of Southampton, UK. We review selected progress and properties of high-power fiber Raman lasers. These can produce power > 1 kW when tandem-pumped and are also starting to realize their potential when diode-pumped. Issues such as mode instabilities are also appearing.	FTh2G.4 • 11:30 Feedback Delay Identification by Time-Dependent Ex- ponent Evaluation for a Chaotic Semiconductor Laser, Xiao-Zhou Li ¹ , Song-Sui Li ¹ , Jun-Ping Zhuang ¹ , Jianbo Gao ^{2,3} , Sze-Chun Chan ^{1,4} ; ¹ Dept. of Electronic Engineering, City Univ. of Hong Kong, China; ² Inst. of Complexity Science and Big Data Technology, Guangxi Univ., China; ³ PMB Intelligence LLC, USA; ⁴ State Key Lab of Millimeter Waves, City Univ. of Hong Kong, China. Feedback delay time of a chaotic laser is experimentally extracted by calculating the time-dependent exponent Λ. The exponent is directly obtained through phase space reconstruction and contains the information of the largest Lyapunov exponent.		LTh2I.3 • 11:30 Observation of Superconductivity in Self-Assembled Indium Island Epitaxially Grown on top of III-V Semiconduc- tors, Michael R. Gehl ¹ , Ricky Gibson ¹ , Sander Zandbergen ¹ , Jasmine Sears ¹ , Nima Nader ^{2,3} , Patrick Keiffer ¹ , Joshua Hendrickson ² , Alexandre Arnoult ^{4,5} , Galina Khitrova ¹ ; ¹ Univ. of Arizona, USA; ² Sensors Directorate, Air Force Research Lab, USA; ³ Solid State Scientific Corporation, USA; ⁴ LAAS- CNRS, France; ⁵ Université de Toulouse, France. Molecular beam epitaxy (MBE) is used to grow indium islands on top of semiconductor structures. Electrical contacts to a single indium island are fabricated. Superconductivity is observed by a drop in the resistance at 3.33K.
	FTh2G.5 • 11:45 A Novel Method for Extracting the Linewidth Broaden- ing Factor of Semiconductor Diode Lasers, Cheng Wang ¹ , Kevin Schires ¹ , Marek Osinski ³ , Philip Poole ² , Frederic Grillot ¹ ; 'Telecom-Paristech, France; 'National Research Council of Canada, Canada; ³ Univ. of New-Mexico, USA. A novel ex- perimental technique for extracting the linewidth broadening factor of semiconductor lasers is proposed. This approach is applicable to any types of diode lasers, both below- and above-threshold, and is insensitive to thermal effects.		LTh21.4 • 11:45 Lasing from As Grown GaAs-AlGaAs Core-Shell Nanowires up to Room Temperature, Zhihuan Wang ¹ , Marc Currie ² , Paola Prete ³ , Nico Lovergine ⁴ , Bahram Nabet ¹ ; ¹ Drexel Univ., USA; ² Optical Sciences Division, Naval Research Lab, USA; ³ IMM-CNR,, Research Unit of Lecce, Italy; ⁴ Dept. of Innova- tion Engineering, Univ. of Salento, Italy. We discuss why as grown GaAs/AlGaAs core-shell nanowires can emit almost three orders of magnitude more light compared to the same material in thin-film and can lase without vertical structure at room temperature.

12:00–13:00 Lunch (on your own)

Thursday, 22 October

California Valley Crystal Gold Empire FiO 13:00-15:00 13:00-15:00 13:00-15:00 13:00-15:00 13:00-15:00 FTh3A • Ultrafast Laser FTh3B • Integrated Photonics FTh3C • Symposium on FTh3D • Quantum FTh3E • Optical Fiber Sensors III: Communications II D Applications I for Communications: Hybrid Applications of Low Noise Devices **D** Presider: Cameron Geddes, Integration on Silicon I Frequency Combs I Presider: Eleni Diamanti; Telecom-Presider: Francesco Baldini, Inst. di Presider: Alwyn Seeds; Univ. Lawrence Livermore National Lab, Presider: Ping Piu Kuo; Univ. of Paristech, France Fisica Applicata Nello Carrara, Italy College London, UK California, San Diego, USA USA FTh3A.1 • 13:00 Tutorial FTh3B.1 • 13:00 Tutorial FTh3C.1 • 13:00 Invited FTh3D.1 • 13:00 Invited FTh3E.1 • 13:00 Invited **Overview of Performance and Progress with** Rethinking and Redesigning the Semicon-Perspective of New Infrastructure of Fiber A Quantum Repeater based on Spectral Mul-Chalcogenide Glass Optical Fibers for Infra-Inertially Confined Fusion Implosions on the ductor Laser for Ultra Coherent Oscillation, tiplexing, Wolfgang Tittel¹; ¹Inst. for Quantum red Spectroscopies, Bruno Bureau¹, Virginie Communication: The Role of Coherent Light National Ignition Facility, Omar Hurricane¹; Amnon Yariv¹; ¹Applied Physics and Materials in SDM Er, Yoshinari Awaji¹, Jun Sakaguchi¹, Science and Technology, Univ. of Calgary, Nazabal¹, Catherine Boussard-Plèdel¹, Johann ¹Lawrence Livermore National Lab, USA. We Science, California Inst. of Technology, USA. Troles¹; ¹Univ. of Rennes, France. Chalcogenide Takahide Sakamoto¹, Atsushi Kanno¹, Motohiro Canada. Future quantum networks will require discuss progress towards fusion ignition on the The spectral linewidth, or equivalently, the tem-Kumagai¹, Ying Li¹, Tetsuya Ido¹, Naoya Wada¹, glasses exhibit excellent transmission in the quantum repeaters to distribute entangled NIF. We cover some of the setbacks encoun-Tetsuya Kawanishi²; ¹National Inst of Information poral coherence, of all lasers is fundamentally photons. I will present a quantum repeater mid-infrared region. They could be shaped into tered during the progress of the research at the limited by quantum mechanics specifically by & Comm Tech, Japan; ²Waseda Univ., Japan. architecture based on spectral multiplexing, various types of optical fibers which have been National Ignition Facility (NIF), but also cover the the quantum nature of light. This limit is largely Recent progresses in optical comb and comdetail system performance, and describe some used for mid-infrared sensing in biology, mediadvances that have been made. The research dependent on the electromagnetic configuramunications technologies are realizing new synrecent experimental key results towards its cine, CO, monitoring or exo-planet detection. strategy for the future will also be discussed. tion of the laser and the atomic nature of the ergies such as switching or frequency-standard implementation. distribution for coherent transmission. Both laser transition applications are quite useful for next generation infrastructure which will sustain enormous traffic. FTh3C.2 • 13:30 FTh3D.2 • 13:30 Invited FTh3E.2 • 13:30 Frequency Combs as Sources for Tbit/s Photonic Quantum Information Processing Nanostructured Sapphire Optical Fiber for Communications Systems, Juerg Leuthold¹, Beyond Single-Photon Qubits, Hyunseok Evanescent-Field Sensing, Hui Chen¹, Fei Christian Hafner¹, David Hillerkuss¹, Arvind K. Jeong¹; ¹Dept. of Physics and Astronomy, Seoul Tian¹, Jiri Kanka², Henry Du¹; ¹Stevens Inst. National Univ., Korea. In this talk, I will discuss of Technology, USA; ²Inst. of Photonics and Mishra²; ¹ETH Zurich, Switzerland; ²Sterlite Technol. Ltd., India. Frequency combs are attractive several schemes for all-optical quantum infor-Electronics, Academy of Sciences of the Czech subcarrier sources for Tbit/s superchannels that mation processing that have been developed Republic, Czech Republic, We here report an innovative and scalable strategy of transformare about to outperform traditional sources. to overcome formidable limitations of the well-Meanwhile a variety of schemes offer up to known approaches based on single-photon ing a commercial unclad sapphire optical fiber Omar Hurricane is a Physicist at Lawrence hundreds of carriers of highest quality across a gubits and continuous-variable states. to an all-alumina nanostructured sapphrie Livermore National Laboratory (LLNL) in the Amnon Yariy received the B.S., M.S., and Ph.D. large spectral range. optical fiber (NSOF). We experimentally and thermonuclear and inertial confinement fusion degrees in electrical engineering from the Uninumerically demonstrate its utility and benefit design division ("AX"). He has also served as versity of California, Berkeley, in 1954, 1956, and for evanescent-field SERS measurements. Program Element Leader of LLNL's AX Division 1958, respectively. In 1959, he joined Bell Telesince 2004 and previously worked as a Senior phone Laboratories, Murray Hill, NJ. In 1964, Scientist at the UCLA Institute of Plasma & Fuhe joined the California Institute of Technology sion Research. He received his B.S. in Physics (Caltech), Pasadena, as an Associate Professor of and Applied Mathematics from Metropolitan electrical engineering, becoming a Professor in State College Denver, and his M.S. and Ph.D. 1966. In 1980, he became the Thomas G. Myers in Physics from the University of California, Los Professor of electrical engineering and applied Angeles (UCLA). physics. In 1996, he became the Martin and Eileen Summerfield Professor of applied physics and Professor of electrical engineering. On the technical and scientific sides, he took part (with various co-workers) in the discovery of a number of early solid-state laser systems, in the original formulation of the theory of nonlinear

quantum optics; in proposing and explaining mode-locked ultrashort-pulse lasers, GaAs optoelectronics; in proposing and demonstrating semiconductor-based integrated optics technology; in pioneering the field of phase conjugate optics; and in proposing and demonstrating the semiconductor distributed feedback laser.

Sacramento

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13:00–15:00 FTh3F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning I Presider: Stephen Kuebler; Univ. of Central

Florida, USA

FTh3F.1 • 13:00 Invited

Imprinted Plasmonic Surfaces as Flexible Reflective Color Displays, Debashis Chanda'; 'Univ. of Central Florida, USA. A flexible reflective plasmonic display has been developed in which each pixel is shown to actively tune across the visible spectrum. This is significant for the development of low cost reflective displays on flexible substrates.

13:00–15:00 FTh3G • Computational Optical Sensing and Imaging II

Presider: Amit Ashok; Univ. of Arizona, USA

FTh3G.1 • 13:00 Invited

Compressive Imaging at Extreme Limits of Coherence, Amit Ashok'; 'Univ. of Arizona, USA. I will describe some recent results in compressive imaging at extreme limits of coherence. In the coherent limit, I will discuss compressive digital holography with sparse apertures and in the incoherent limit, I will talk about X-ray threat detection using compressive multiplexed measurements. **13:00–15:00 FTh3H • Fiber Lasers and Amplifiers** *Presider: Johan Nilsson; Univ. of Southampton, UK*

FTh3H.1 • 13:00 Tutorial

Raman Fiber Lasers and Amplifiers, Roger H. Stolen¹; ¹COMSET, Clemson Univ., USA. Raman gain is opticallypumped optical amplification. We discuss the discovery of the Raman effect and Raman amplification. Relevant fiber properties are introduced along with an overview of different approaches to Raman amplification. Applications as lasers and lightwave system amplifiers are shown.



Roger Stolen is a distinguished visiting professor at the Center for Optical Materials Science and Engineering Technologies (COMSET) at Clemson University. He was with Bell Labs and AT&T Research from 1966 to 1998 and the Dept of Electrical Engineering of Virginia Tech until 2004. Since 1971 he has been involved with most aspects of fiber optics research. In 1990 he was awarded the R.W.Wood prize in recognition of pioneering studies of optical nonlinearities in fibers and the demonstration of polarization preserving fibers and in 2005 he received the IEEE/OSA John Tyndall Award for contributions to the fundamentals of the nonlinear properties of fibers. He was inducted as a foreign member of the Russian Academy of Science in 2009 and became a member of the National Academy of Engineering in 2012. 13:00–15:00 LTh3I • Innovative Metallic-Emitter Coupled Systems III Presider: Alexander Poddubny; loffe Inst., Russia

LTh3I.1 • 13:00 Invited

Automated Optimization of Photonic Crystals for Broadband Slow Light and Ultra-High-Q Cavities, Vincenzo Savona¹, Momchil Minkov¹; ¹Ecole Polytechnique Federale de Lausanne, Switzerland. Using an automated optimization procedure, we design ultra-high-Q photonic crystal cavities and slow-light waveguides, improving dramatically on previous best figures of merit. These structures, partly experimentally demonstrated, hold great promise for nanostructured hybrid devices.

LTh3I.2 • 13:30

Lasing Characteristics of Two Dimensional Surface Plasmon Lasers in an Active Meta-Material, Vasco T. Tenner', Michiel J A de Dood', Martin P van Exter'; 'Quantum Matter & Optics, Huygens-Kamerlingh Onnes Laboratorium, Universiteit Leiden, Netherlands. We have studied surface-plasmons on metal hole arrays combined with gain and observe surface plasmon laser action. We will discuss the feedback mechanism, angular beam profile, and spatial emission profile of this surface plasmon laser.

FTh3F.2 • 13:30

Chalcogenide Glass Processing for Direct Laser Writing of 3D Nano-Structures, Stephen M. Kuebler¹, Casey Schwarz¹, Chris Grabill¹, Shreya Labh¹, Gerald Richardson¹, Clara Rivero-Baleine², Kathleen Richardson¹, Alexej Pogrebnyakov³, Theresa Mayer²; ¹Univ. of Central Florida, USA; ²Lockheed Martin, USA; ³Pennsylvania State Univ., USA. Multi-photon direct laser writing was used to photo-pattern nano-structures in thermally deposited glassy films of chalcogenide (ChG) clusters. Chemical composition, refractive index, and nano-structure morphology were characterized and related to ChG laser and etch processing.

FTh3G.2 • 13:30 Invited

Fourier Ptychography for Multimodal Imaging, Guoan Zheng'; 'Univ. of Connecticut, USA. We will discuss the recent progresses of the Fourier ptychographic imaging approach. We will demonstrate its applications in gigapixel microscopy, quantitative phase imaging, spectrum multiplexing, 3D holographic imaging, super-resolution fluorescence microscopy, and photographic imaging.

California	Valley	Crystal	Gold	Empire
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FTh3A • Ultrafast Laser Applications I—Continued	FTh3B • Integrated Photonics for Communications: Hybrid Integration on Silicon I— Continued	FTh3C • Symposium on Applications of Low Noise Frequency Combs I—Continued	FTh3D • Quantum Communications II—Continued	FTh3E • Optical Fiber Sensors III: Devices—Continued
FTh3A.2 • 13:45 Free Induction Decay in the Extreme Ultra- violet, Samuel Bengtsson ¹ , Esben W. Larsen ¹ , David kroon ¹ , Cord Arnold ¹ , Anne L'Huillier ¹ , Lars Rippe ¹ , Johan Mauritsson ¹ ; 'Lunds Uni- versitet, Sweden. We present an experimental study of controlled Free Induction Decay (FID) in the extreme ultraviolet regime excited by High-order Harmonics. The control is done by applying a delayed infrared pulse.	FTh3B.2 • 13:45 Invited WiO Hybrid Long-wavelength VCSEL using High Contrast Metastructure on SOI, Connie J. Chang-Hasnain ¹ , James Ferrara ¹ ; ¹ Univ. of Cali- fornia Berkeley, USA. An electrically-pumped III-V-silicon hybrid VCSEL using a high-contrast metastructure (HCM) reflector on SOI with CW output >1 mW, 1.46 K/mW thermal resistance, and 5 Gb/s direct modulation is presented. The grating can provide in-plane waveguide coupling.			FTh3E.3 • 13:45 D WIO Chirped Fiber Optical Current Sensor Based on Graded Terfenol-D Composite, Suha Lasassmeh', Edward Lynch', Chiu T. Law', Rani El-Hajjar'; 'Univ. of Wisconsin Milwaukee, USA. This paper presents a magnetostriction-based optical current sensor with wide dynamic range. It consists of a fiber Bragg grating embedded in a magnetostrictive composite with graded par- ticle size distribution converting magnetostric- tive strain into frequency chirp in proportional to magnetic field.
FTh3A.3 • 14:00 Observation of Dynamical Localization and Bloch Oscillations within Molecular Alignment of Nitrogen, andrei kamalov ¹ , Johannes Floss ² , Doug Broege ¹ , Ilya Averbukh ² , Philip H. Bucks- baum ¹ ; 'SLAC National Lab, USA; ² Chemistry, Weizmann Inst. of Science, Israel. Nitrogen gas is rotationally excited by a train of eight impul- sive kicks. The resulting population alignment evolution exhibits two phenomena explained by analogy to the famous condensed matter effects of dynamical localization and Bloch oscillations.		FTh3C.3 • 14:00 Invited C FTh3C.3 • 14:00 Invited C FTh3C.3 • 14:00 For High-Performance Datacenters: Challenges and Strategies, Takashi Inoue ¹ , Takayuki Kurosu ¹ , Kiyo Ishii ¹ , Haruhiko Kuwatsuka ¹ , Shu Namiki ¹ ; 'Natl Inst of Adv Industrial Sci & Tech, Japan. A design concept of optical network enabling Exabit/s interconnect between 100,000 nodes for future high-performance datacenters is discussed, where distributed optical frequency comb plays an important role in realizing high-capacity and energy-efficient WDM transmission.	FTh3D.3 • 14:00 C Towards the spin-wave storage of entangled photons in a solid state quantum memory, Daniel Rieländer', Alessandro Seri', Margherita Mazzera', Hugues de Riedmatten ^{1,2} ; 'ICFO – The Inst. of Photonic Science, Spain; ² ICREA - Insti- tució Catalana de Recerca i Estudis Avançats, Spain. We will show our progress on storage of entangled heralded single photons in the spin state of a solid state quantum memory.	FTh3E.4 • 14:00 C Utra-Thin Multi-Parameter Sensor Achieved with on-Fiber Plasmonic Interferometer, Zhijian Zhang ¹ , Yongyao Chen ¹ , Haijun Liu ³ , Hyungdae Bae ¹ , Douglas A. Olson ² , Ashwani K. Gupta ¹ , Miao Yu ¹ ; ¹ Dept. of Mechanical Engineering, Univ. of Maryland, USA; ³ National Inst. of Standards and Technology, USA; ³ Dept. of Mechanical Engineering, Temple Univ., USA. We demonstrate the multi-parameter sensing capability of an ultra-thin plasmonic interferometer fabricated on a fiber facet. High refractive index and temperature sensitivities are achieved.
FTh3A.4 • 14:15 The polarization of the SHG in single ZnS NWs, Hu Hongbo ¹ , Kai Wang ¹ , Bing Wang ¹ , Peixiang Lu ¹ ; ¹ Huazhong Univ. of Science and Technology, China. We use the electrical-dipole approximation to study the polarization of SHG in single ZnS NWs. The polarization of SHG orientations and the polarization directions of pumping laser.	FTh3B.3 • 14:15 Invited High Bandwidth Transceivers Using Hetero- geneous Integration on Silicon, Gregory Fish ¹ , Jon Roth ¹ , Anand Ramaswamy ¹ , Erik Norberg ¹ , Robert Guzzon ¹ , Jae Shin ¹ , Brian Koch ¹ , Sparacin Dan ¹ ; 'Aurrion, Inc., USA. The heterogeneous integration of InP material into a silicon pho- tonics wafer flow enables high bandwidth transceivers to be fabricated using established silicon foundry infrastructure for both fabrication and packaging.		FTh3D.4 • 14:15 O Quantum Hyperdense Coding, Trent M. Graham', Christopher Zeitler', Paul G. Kwiat'; 'Univ of Illinois at Urbana-Champaign, USA. We use photons simultaneously entangled in polarization and temporal mode to implement hyperdense coding, a quantum-enhanced com- munication protocol that can transmit up to 2.81 bits of classical information for every 2-qubit photon received.	FTh3E.5 • 14:15 All SMF Inline Mach-Zehnder Interferometer with Micro Cavity for Curvature Sensing, Sumit Dass', Jitendra Dash', Rajan Jha'; 'J.J.T. Bhubaneswar, India. We propose cascaded taper based Mach-Zehnder interferometer with micro cavity as highly sensitive curvature sensor. Experimental results show that by changing the tapering parameters of second taper, curvature sensitivity of the system can be tailored.

Glen Ellen	Sacramento	Hillsborough	Piedmont
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FTh3F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning I—Continued	FTh3G • Computational Optical Sensing and Imaging II—Continued	FTh3H • Fiber Lasers and Amplifiers— Continued	LTh3I • Innovative Metallic-Emitter Coupled Systems III—Continued
FTh3F.3 • 13:45 Atomic-layer lithography of sub-10-nm plasmonic na- nogaps on flat metallic surface, Dengxin Ji ¹ , Borui Chen ¹ , Xie Zeng ¹ , Tania Moein ¹ , Haomin Song ¹ , Nan Zhang ¹ , Qiaoq- iang Gan ¹ , Alexander Cartwright ² , ¹ State Univ. of New York at Buffalo, USA; ² State Univ. of New York, USA. We developed a novel atomic layer lithography procedure to fabricate large area flat metallic surfaces with sub-10-nm features, which is particularly useful for fabrication of nanostructures with strongly localized field enhancement.		FTh3H.2 • 13:45 Analysis of Nonlinear Optical and Dynamic Gain Effects of Moderate-Power, Pulse-Position-Modulated, Erbium- Doped Fiber Amplifiers for Deep-Space Applications, Haomin Yao ¹ , Malcolm W. Wright ² , John R. Marciante ¹ , ¹ The Inst. of Optics, Univ. of Rochester, USA; ² Jet Propulsion Lab, California Inst. of Technology, USA. Self-phase modulation and stimulated Raman scattering are analyzed and limit the usable data-format space. Output pulse energy variation and square-pulse distortion, as large as 28% and 21% respectively, primarily depend on symbol duration.	
FTh3F.4 • 14:00 Negative Index in a Lossy Chiral Metamaterial under First-Order Material Dispersion using a Drude Model, tarig algadey ¹ , Monish R. Chatterjee ¹ ; 'Univ. of Dayton, USA. Using the Drude model for complex conductivity, phase and group velocities, and indices are calculated under first-order disper- sion in chiral metamaterials. Conditions are derived for nega- tive index, and the results compared with parametric analyses.	FTh3G.3 • 14:00 High-Contrast 3D Surface Topographic Imaging With Near Wavelength-Limited Resolution Using Ptychography, Dennis F. Gardner ¹ , Elisabeth Shanblatt ¹ , Bosheng Zhang ¹ , Matthew Seaberg ¹ , Christina Porter ¹ , Robert Karl ¹ , Michael Tanksalvala ¹ , Margaret Murnane ¹ , Henry Kapteyn ¹ , Daniel Adams ¹ , ¹ Univ. of Colorado at Boulder, USA. We achieve high-contrast, 3D surface topographic imaging with a lateral resolution of 1.3A and with 6A axial precision using ptycho- graphic coherent diffraction imaging and a high-harmonic source at 30nm.	FTh3H.3 • 14:00 Observation of continuous evolution of the output state of polarization from a polarization-rotated, mode-locked soliton fiber laser, Guoqing Hu ¹ , Xin Zhao ¹ , Zijun Yao ¹ , Meng Zhang ¹ , Zheng Zheng ^{1,2} ; 'School of Electronic and Information Engineering, Beihang Univ., China; ² Collaborative Innova- tion Center of Geospatial Technology, China. The output of a soliton fiber laser is observed to remain mode-locked and continuously evolve between orthogonal scalar states and vector soliton states, even as an intracavity polarizer is rotated over a range of 90°.	LTh31.3 • 14:00 Threshold Analysis in Monolayer Semiconductor Nanolaser by Surface Plasmon Enhancement, Xiang Meng ¹ , Richard Grote ¹ , Jerry Dadap ¹ , Richard Osgood ¹ ; ¹ Columbia Univ., USA. We have examined the lasing threshold requirements for optically pumped surface plasmon based nanolasers with 2D materials as active medium, which is an excellent research tool as an on-chip nanoscale light source.
FTh3F.5 • 14:15 Circularly Polarized Light Detection with Hot Electrons in	FTh3G.4 • 14:15 Extracting Full Susceptibility Tensor Using Modified Opti-	FTh3H.4 • 14:15 Numerical Study on Multimode-fiber-based Random	LTh3I.4 • 14:15 Controlling Electric and Magnetic Resonances for Ultra-

Circularly Polarized Light Detection with Flot Electrons in Chiral Plasmonic Metamaterials, Wei Li¹, Zachary J. Coppens¹, Lucas Vázquez², Wenyi Wang³, Alexander O. Govorov², Jason Valentine¹; ¹Mechanical Engineering, Vanderbilt Univ., USA; ²Dept. of Physics and Astronomy, Ohio Univ., USA; ³Electrical Engineering, Vanderbilt Univ., USA. We report on a circularly polarized light detector based on chiral plasmonic metamaterials and hot electron injection. The detector has the ability to distinguish left and right hand circularly polarized light without additional optical elements. Extracting Full Susceptibility Tensor Using Modified Optical Coherence Tomography, Yang Xu¹, Fredrick A. South¹, Yuan-Zhi Liu¹, Stephen A. Boppart¹, Paul S. Carney¹; ¹Univ of Illinois at Urbana-Champaign, USA. We present a method of measuring the full susceptibility tensor map of samples using a modified high numerical aperture (NA) optical coherence tomography (OCT) system. This method promises high resolution, angle invariant results with significantly extended depth of field (DoF). Numerical Study on Multimode-fiber-based Random Fiber Laser, Han Wu¹, Zinan Wang¹, Mengqiu Fan¹, Yunjiang Rao¹; ¹Univ. Electronic Sci. & Tech. of China, China. We make a numerical study on the power performance of backward-pumped random fiber laser (RFL) based on short graded-index multimode fiber (MMF). Comparing with its SMF-based counterpart, the MMF-based RFL has the lower threshold and comparable slope efficiency. Controlling Electric and Magnetic Resonances for Ultra-Compact Nanoantennas with Switchable Directionality, Kan Yao², Yongmin Liu^{1,2}; ¹Dept. of Mechanical and Industrial Engineering, Northeastern Univ., USA; ²Dept. of Electrical and Computer Engineering, Northeastern Univ., USA. We design and demonstrate an ultra-compact nanoantenna composed of an asymmetric trimer. The structure can support a highly tunable magnetic resonance in addition to the electric resonance, resulting in switchable directionality and enhanced radiative emission.

California	Valley	Crystal	Gold	Empire
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FTh3A • Ultrafast Laser Applications I—Continued	FTh3B • Integrated Photonics for Communications: Hybrid Integration on Silicon I— Continued	FTh3C • Symposium on Applications of Low Noise Frequency Combs I—Continued	FTh3D • Quantum Communications II—Continued	FTh3E • Optical Fiber Sensors III: Devices—Continued
FTh3A.5 • 14:30 Liquid Crystals as High Repetition Rate Tar- gets for Ultra Intense Laser Systems, Patrick Poole ¹ , Christopher Willis ¹ , Ginevra Cochran ¹ , Matthew McMahon ¹ , Enam Chowdhury ¹ , C. David Andereck ¹ , Douglass Schumacher ¹ ; ¹ Ohio State Univ. , USA. Liquid crystal film targets are presented with on-demand thickness control for use in experiments such as laser ion accelera- tion, where thickness manipulation is critical. Variation from 10 nm to 10 µm with a positional reproducibility better than 2 µm and repetition rate exceeding 0.3 Hz.		FTh3C.4 • 14:30 Invited Digital Coherence V-band Radio-over-fiber System, Ken-ichi Kitayama', Nikolaos P. Dia- mantopoulos', Yuki Yoshida', Atsushi Kanno ² , Tetsuya Kawanishi ^{2,3} ; 'Osaka Univ., Japan; ² Electronic and Physical Systems, Waseda Univ., Japan; ³ National Inst. of Information and Communications Technology, Japan. W-band RoF transmission system with converged MIMO DSP for compensating signal impairments both in optical fiber and free-space is presented, particularly focusing on MDM transmission in a low differential mode group delay two-mode fiber link.	FTh3D.5 • 14:30 Exploring a Four-Cubit Hilbert Space Using Hyperentangled Photons, Aditya N. Sharma ¹ , Kevin McCusker ² , Julio Barreiro ³ , Paul G. Kwiat ¹ ; ¹ Dept. of Physics, Univ. of Illinois at Urbana-Champaign, USA; ² Center for Photonic Communication and Computing, Northwest- ern Unitersity, USA; ³ Dept. of Physics, Univ. of California at San Diego, USA. We present an experimental realization of the Smolin state using hyperentangled photon pairs from spontaneous parametric downconversion, to our knowledge the first optical demonstration of bound entanglement that does not simulate mixture using random unitaries.	FTh3E.6 • 14:30 Invited C Miniaturized Fiber Bragg Grating Interrog tor based on an Arrayed Waveguide Gratin in SOI platform, Andrea Trita ² , Eli Voet ³ , J. Vermeiren ⁴ , Danae Delbeke ¹ , Pieter Dumon Shibnath Pathak ¹ , Dries Van Thourhout ¹ ; ¹ Ghe Univ., INTEC, Belgium; ² Rockley Photonics In USA; ³ Com&Sens, Belgium; ⁴ Xenics nv, Belgiu ⁵ Luceda Photonics, Belgium. We experimenta demonstrated a novel miniaturized Fiber-Brag Grating sensor interrogator, based on a tailoror Arrayed-Waveguide-Grating (AWG) filter fab cated in the Silicon-on-Insulator (SOI) platforn The measured interrogator resolution is 10p on a 50nm operational bandwidth.
FTh3A.6 • 14:45 Approaching the Abbe Limit in the Extreme Ultraviolet: Ultrafast Imaging Using a Com- pact High Average Power High Harmonic Source, Michael Zürch ¹ , Jan Rothhardt ^{2,3} , Steffen Hädrich ^{2,3} , Stefan Demmler ² , Manuel Krebs ² , Jens Limpert ^{2,3} , Andreas Tünnermann ^{2,4} , Alex- ander Guggenmos ^{5,6} , Ulf Kleineberg ^{5,6} , Christian Spielmann ^{1,3} ; ¹ Inst. of Optics and Quantum Electronics, Friedrich Schiller Univ. Jena, Ger- many; ² Inst. of Applied Physics, Friedrich Schiller Univ. Jena, Germany; ³ Helmholtz Inst. Jena, Germany; ⁴ Fraunhofer Inst. for Applied Optics and Precision Engineering, Germany; ¹ Max-Planck-Institut für Quantenoptik, Germany; ⁴ Max-Planck-Institut für Quantenoptik, Germany; ⁴ Max-Planck-Institut für Quantenoptik, Germany; ⁹ Max-Planck-Institut für Quantenoptik, Germany; ⁹ May Planck-Institut für Quantenoptik, Germany; ⁹ Max-Planck-Institut für Quantenoptik, Germany; ⁹ Max-Planck-Insti	FTh3B.4 • 14:45 C Low Power Compensation of Thermal Drift in Hydrid Silicon and Lithium Niobate Ring Reso- nators, Li Chen', Michael G. Wood', Ronald M. Reano'; 'Ohio State Univ. USA. We present active compensation of thermal drift of hybrid silicon and lithium niobate ring resonances. A capacitive geometry and low thermal sensitiv- ity results in 17 °C temperature compensation using tuning power at the sub-nanowatt level.		FTh3D.6 • 14:45 Multiplexing single-photon orbital angu- far momentum states in fiber - Limits to dephasing correction via dynamical de- coupling, Manish Kumar Gupta ^{2,1} , Jonathan P. Dowling ^{2,1} ; 'Louisiana State Univ., USA; ² Hearne Inst. for Theoretical Physics, USA. We derive a decoherence model for OAM states of a photon in a multimode optical fiber and show that rate of decoherence is proportional to \$I^2\$, where \$I\$ is the azimuthal mode order. We also show numeri- cally that for lower values of I the decoherence can be minimized by using dynamical decoupling.	

15:00–15:30 Coffee Break, Market Street & South Tower Foyers

Sacramento

FiO

FTh3G • Computational Optical Sensing

Hillsborough

Er-Doped Semi-Guiding High-Aspect-Ratio Core (SHARC)

Fiber Amplifier Generating 100 µJ, 1-nsec Pulses at 30

kHz, David A, Rockwell¹, Friedrich Strohkendl¹, Sean Moore¹,

Vladimir Shkunov¹, Fabio Di Teodoro¹, John Marciante²;

¹Raytheon Company, USA; ²U. Rochester, USA. We describe

an Er:SHARC fiber amplifier generating 1-nsec pulses hav-

ing peak powers approaching 100 kW at a 30 kHz repetition

rate. Pulse energies of 0.9 mJ were achieved with a longer

FTh3H • Fiber Lasers and Amplifiers—

Continued

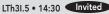
FTh3H.5 • 14:30 Invited

pulse length of 15 nsec.

Piedmont

LS

LTh3I • Innovative Metallic-Emitter Coupled Systems III—Continued



Ab Initio Studies of Structure and Excited States of Organic-Based Semiconductors, Jeffrey Neaton^{2,1}; ¹Molecular Foundry, Lawrence Berkeley National Lab, USA; ²Dept. of Physics, Univ. of California, Berkeley, USA. I will discuss the use of density functional theory and many-body perturbation theory – within the GW approximation and BSE approach – for understanding structure and excited-states of organic materials, e.g. acene crystals and halide perovskites.

FTh3F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning I—Continued

FTh3F.6 • 14:30

Perfect Absorption in Ultra-thin Uniform and Nanostructured Media, C. Martijn de Sterke¹, Björn C. P. Sturmberg¹, Lindsay C. Botten^{2,3}, Christopher G. Poulton³, Kokou B. Dossou³, Ross C. McPhedran¹, ¹Centre for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS), School of Physics, Univ. of Sydney, Australia; ²National Computational Infrastructure, Australian National Univ., Australia; ³Centre for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS), School of Mathematical and Physical Sciences, Univ. of Technology Sydney, Australia: We show that perfect absorption can be achieved in ultra-thin gratings composed of weakly absorbing dielectric materials combined with a mirror. The structures can be fabricated using standard processing techniques.

FTh3F.7 • 14:45

Aperiodic Gap Plasmon Resonators for Unidirectional Launching and Shaping of Surface Plasmon Polaritons, Zeyu Lei¹, Tian Yang¹; 'Shanghai Jiao Tong Univ., China. We report a compact device for the efficient launching of unidirectional surface plasmon polaritons (SPPs). Unidirectional SPPs with focused, Bessel and Airy profiles have also been experimentally realized by adjusting the wavefront.

FTh3G.5 • 14:30 WiO From Frequency Domain Multi-Focus Fusion to Focus Slicing. Julia Alonso¹. José Ferrari¹: ¹Universidad de la Republica.

and Imaging II—Continued

ing, Julia Alonso¹, José Ferrari¹; ¹Universidad de la Republica, Uruguay. For optical systems under severe defocus, we propose a method to estimate the focus slices (i.e. in-focus region of each of the acquired images of a stack) from Fourier based all-in-focus reconstructed image. Experimental results are provided.

FTh3G.6 • 14:45

Multi-perspective Fluorescence Talbot Microscopy, Yangyang Sun¹, Shuo Pang¹; 'CREOL, Univ. of Central Florida, USA. We demonstrate a long imaging depth, multi-perspective fluorescence scanning microscopy based on Talbot effect generated from a microlens array. An object with two layers that are 155µm apart was reconstructed from different perspectives.

15:00–15:30 Coffee Break, Market Street & South Tower Foyers

California	Valley	Crystal	Gold	Empire
FiO			LS	FiO
15:30–17:30 FTh4A • Ultrafast Laser Applications II Presider: Laszlo Veisz; Max-Planck- Institut fur Quantenoptik, Germany	15:30–17:30 FTh4B • Integrated Photonics for Communications: Hybrid Integration on Silicon II Presider: Sasan Fathpour; Univ. of Central Florida, CREOL, USA	15:30–17:30 FTh4C • Symposium on Applications of Low Noise Frequency Combs II O Presider: Bill Kuo, Univ. of California San Diego, USA	15:30–17:15 LTh4D • Complex Dynamics Presider: Aristide Dogariu, Univ. of Central Florida, CREOL, USA	15:30–17:30 FTh4E • Optical Fiber Sensors IV: Methods Presider: Bruno Bureau; Universite de Rennes I, France
FTh4A.1 • 15:30 Invited WiO High Intensity Laser-driven X-ray Sources for High Energy Density Science, Félicie Albert'; 'Lawrence Livermore National Lab, USA. We discuss betatron x-ray radiation from laser wake- field accelerators using femtosecond (blowout regime) and picosecond (self modulated and direct laser acceleration regimes) scale laser pulses. The source will have applications for high energy density science.	FTh4B.1 • 15:30 C Detection of Optical Plasmons Using an Atomically-Thin Semiconductor, Kenneth M. Goodfellow ¹ , Chitraleema Chakraborty ¹ , Ryan Beams ¹ , Nick Vamivakas ¹ , Lukas Novotny ² ; ¹ Univ. of Rochester, USA; ² ETH Zurich, Switzerland. We demonstrate near-field electrical detection of silver nanowire plasmons with the atomically- thin semiconductor molybdenum disulfide. Our device exhibits plasmon-to-charge conversion efficiencies of 0.5 and plasmon reponsivities better than 250 mA/W.	FTh4C.1 • 15:30 Invited C Optical-to-RF Frequency Synthesis: Applica- tion Priorities for Ultra-low Phase Noise, David Howe', Archita Hati', Lora Nugent-Glandorf'; 'Time and Frequency Division, National Inst. of Standards and Technology , USA. We de- scribe operational challenges and progress of optical frequency-comb dividers (OFDs) that synthesize RF signals from the optical domain. Our priorities include: (1) ultra-low phase-noise, (2) continuous operation, and (3) broadly low Allan deviation.	LTh4D.1 • 15:30 Semiconductor microstructure optical resona- tors, Hongxing Dong ² , Liaoxin Sun ¹ , Yang Liu ² , Zhanghai Chen ¹ , Long Zhang ² ; 'Fudan Univ., China; ² Shanghai Inst. of Optics and Fine Me- chanics, China. High quality ZnO microstructure optical cavities with different morphologies were fabricated. By using the spatially resolved spec- troscopic technique, optical resonant modes were directly observed and further investigated systematically.	FTh4E.1 • 15:30 Invited Distributed Acoustic Sensing (DAS): Theory and Applications, David Hill'; 'OptaSense, UK. Exploiting the effect of Rayleigh backscatter in optical fibers, Distributed Acoustic Sensing (DAS) has emerged as a powerful and rapidly adopted sensing technology with a broad range of uses across a wide assortment of industries.
	FTh4B.2 • 15:45 Invited O Hybrid Photonic Integration, John Dallesasse ¹ , B Kesler ¹ , T O'Brien ¹ , G.L. Su ¹ , J Carlson ¹ ; ¹ Dept. of Electrical and Computer Engineering, Univ. of Illinois at Urbana-Champaign, USA. Integra- tion of compound semiconductors with CMOS provides a path for improving performance and increasing functionality. Methods for integrating photonic materials are examined, and the result- ing thermal environment modeled. Integration of III-N materials is also discussed.		LTh4D.2 • 15:45 Coupled Opto-Electronic Oscillator with Three-Point Stabilization, Anthony Klee ¹ , Kristina Bagnell ¹ , Peter Delfyett ¹ ; ¹ Univ. of Central Florida, CREOL, USA. We present a coupled opto-electronic oscillator architec- ture with independent stabilization of optical frequency and mode spacing. Decoupling the two parameters is accomplished by filtering the spectrum into three regions for generation of unique error signals.	
FTh4A.2 • 16:00 A 260 MW light source with 7 \mu m wave- length as a path to strong field science in the far infrared., Derrek Wilson ¹ , Adam M. Sum- mers ¹ , Carlos Trallero-Herrero ¹ ; <i>1Kansas State</i> <i>Univ., USA.</i> We demonstrate a far infrared source (7 \mu m) with pulse duration of < 120 fs and pulse energies of 31 mJ. Additionally, we show a clear path to achieving GW level peak power.		FTh4C.2 • 16:00 Invited C Withdrawn.	LTh4D.3 • 16:00 Simulations of the Optical Bichromatic Force in Multilevel Systems, Leland Aldridge ¹ , Scott E. Galica ¹ , Edward E. Eyler ¹ ; ¹ Univ. of Connecti- cut, USA. The optical bichromatic force (BCF) shows promise for improved laser slowing and cooling of molecules. We are investigating BCF dynamics in multilevel systems using numerical simulations, in conjunction with experimental tests on the CaF molecule.	FTh4E.2 • 16:00 Athermal Compensation of Source Wave- length Drifts for Fiber-Optic Current Sensors, Georg M. Müller ¹ , Wei Quan ¹ , Miklós Lenner ¹ , Lin Yang ¹ , Andreas Frank ¹ , Klaus Bohnert ¹ ; ¹ ABB Corporate Research, Switzerland. An athermal fiber-optic retarder introduces controlled wave- length dependent cross-coupling between the two orthogonal polarization states of a fiber- optic current sensor and thus compensates the wavelength dependence of the Faraday effect.

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15:30–17:30 FTh4F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning II

Presider: Debashis Chanda, Univ. of Central Florida, USA

FTh4F.1 • 15:30 Invited WiO

Ink Deposition of Quaternary Amorphous Oxide Semiconductors for Electronic and Optoelectronic Devices, Chun-Li Lo¹, Rebecca L. Peterson¹; ¹Univ. of Michigan, USA. High-quality amorphous oxide thin films with band-edge absorption in the ultraviolet are deposited using a sol-gel ink process. We control optical and electrical properties of semiconducting zinc tin oxide by incorporating quaternary alloy elements. 15:30–17:30 FTh4G • Computational Optical Sensing and Imaging III Presider: Guoan Zheng; Univ. of Connecticut, USA

FTh4D.1 • 15:30

Adaptive Allocation of Measurement Time for Imaging Interferometry, Zachary DeSantis¹, James R. Fienup¹; ¹Univ. of Rochester, USA. Imaging interferometry has a significant challenge balancing cost and measurement time. We propose a method for reducing the total measurement time, by adaptively measuring the Fourier domain, with a favorable impact on the image quality.

FTh4D.2 • 15:45

Self-interference digital polarization holography for threedimensional incoherent imaging, Ziyi Zhu¹, Zhimin Zhi¹; ¹Dept. of Physics, Univ. of South Florida, USA. We present a self-interference digital polarization holography method for 3-D imaging of an incoherent scene in a single shot. The 3-D imaging capability is quantitatively demonstrated with controllable time-multiplexed incoherent scenes.

FTh4F.2 • 16:00

2D Photonic-Crystal Waveguide Structures and 3D Periodic-Lattice-Based Microstructures by Pattern-Integrated Interference Lithography, Matthieu C. Leibovici¹, Thomas K. Gaylord¹, ¹Georgia Inst. of Technology, USA. We report the fabrication of photonic-crystal waveguide structures by pattern-integrated interference lithography. Experiments are in excellent agreement with simulations. Preliminary results for three-dimensional microstructure fabrication are presented as well.

FTh4D.3 • 16:00

Enhanced-resolution by Sparse Synthetic Aperture with Fresnel Elements (S-SAFE), Yuval Kashter², Yair Rivenson³, Adrian Stern¹, Joseph Rosen²; ¹Dept. of Electro-Optics Engineering, Ben gurion Univ., Israel; ²Dept. of Electroid & Computer Engineering, Ben-Gurion Univ. of the Negev, Israel; ³Faculty of Engineering, Bar-Ilan Univ., Israel. We present an advanced configuration of an incoherent holographic imaging system with a partial synthetic aperture. The image resolution of the physical aperture-limited system is significantly enhanced although the synthetic aperture is sparse.

15:30–17:15 LTh4H • Stable Laser Systems Presider: Jill Scott, Idaho National Lab, USA

LTh4H.1 • 15:30

Frequency Stabilization of an External Cavity Diode Laser using Helium 25-3P Saturated Absorption Transitions, Chia-Wei Chen¹, Jow-Tsong Shy², Pei-Ling Luo², Li-Bang Wang², Hsiang-Chen Chui¹; 'National Cheng Kung Univ, Taiwan; ²Physics, National Tsing Hua Univ., Taiwan. We reported the frequency of an external cavity diode laser was locked on He-4 2S-3P hyperfine transitions in a RF-discharged helium cell using a 10-mW 389-nn laser. The S/N ratio and performance were investigated.

LTh4H.2 • 15:45

Collective State Atomic Clock: Experimental Investigation and Application to Spin-Squeezing, Renpeng Fang¹, May E. Kim¹, Resham Sarkar¹, Selim Shahriar¹; ¹Northwestern Univ., USA. We describe our effort towards experimental demonstration of an N-atom collective state atomic clock which produces a root-N narrowing of Ramsey fringes, and the application thereof to the generation and efficient detection of spin squeezing.

LTh4H.3 • 16:00

Self-heterodyne Measurement of Mode Evolution in High-Power Diode Lasers, Jordan P. Leidner¹, John R. Marciante¹; ¹The Inst. of Optics, USA. Self-heterodyne measurements of beat frequencies between broad-area laser lateral and longitudinal modes are spatially resolved to generate spatio-spectral mappings of mode beat frequencies. Evolution with power is used as evidence to indicate spatial coherence collapse.

15:30–17:30 LTh4I • Novel Laser Systems Presider: Ken-ichi Kitayama; Osaka Univ., Japan

LTh4I.1 • 15:30

LS

Final EDP Ti: Sapphire Amplifiers for New Generation of Ultra-High Power Laser Systems, Vladimir V. Chvykov¹, Mikhail Kalashnikov¹, Károly Osvay¹; ¹ELI-ALPS, Hungary. We studied the concept of EDP amplification for the 10-100 PW level of the three ELI-pillars laser systems. The design of EDP – duty amplifiers required to achieve these parameters was done and will be reported.

LTh4I.2 • 15:45

Polarization of the Airy Beam, Sean M. Nomoto¹, A. Aadhi², Shashi Prahbakar², R. P. Singh², Reeta Vyas¹, Surendra Singh¹, ¹Univ. of Arkansas, USA; ²Theoretical Physics Division, Physical Research Lab, India. Evolution of the polarization profile of finite aperture Maxwell-Airy beams with propagation was studied experimentally. Existence of the cross polarization of the Airy beam is demonstrated.

LTh4I.3 • 16:00

Unveiling the OAM and Acceleration of Vortex and Airy Beams, Roy Shiloh', Yuval Tsur', Roei Remez', Yossi Lereah', Boris A. Malomed', Vladlen Shvedov², Cyril Hnatovsky², Wieslaw Krolikowski², Ady Arie'; 'Tel-Aviv Univ., Israel; 'Australian National Univ., Australia. The Astigmatic Airy beam is introduced, and accurate, closed-form expressions are derived using ray-tracing methods. These expressions are confirmed in experiment in an extraordinary optical system: the transmission electron microscope.

California	Valley	Crystal	Gold	Empire
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FTh4A • Ultrafast Laser Applications II—Continued	FTh4B • Integrated Photonics for Communications: Hybrid Integration on Silicon II— Continued	FTh4C • Symposium on Applications of Low Noise Frequency Combs II—Continued	LTh4D • Complex Dynamics— Continued	FTh4E • Optical Fiber Sensors IV: Methods—Continued
FTh4A.3 • 16:15 Improved Method of Pulse Width Stabilization for Picosecond Mode-locked Yb-doped Fiber Laser, Vladimir A. Lazarev ¹ , Dmitriy Shelestov ¹ , Kirill Koshelev ¹ , Alexey Pnev ¹ , Valery Karasik ¹ , Anatoly Grudinin ² ; ¹ Bauman Moscow State Technical Univ, Russia; ² Fianium Ltd, UK. We developed an improved method based on SHG technique for pulse width stabilization of picosecond Yb-doped fiber laser with absolute error less than 200 fs.	FTh4B.3 • 16:15 Tutorial O Quantum Dot Lasers on Silicon by Direct Epitaxial Growth , Alwyn J. Seeds ¹ , Jiang Wu ¹ , Siming Chen ¹ , Mingchu Tang ¹ , Qi Jiang ¹ , Huiyun Liu ¹ ; ¹ <i>Unix. College London, UK.</i> Although many silicon photonic devices have been demon- strated, efficient, electrically pumped on-chip light sources have not been realised due to the indirect bandgap of silicon. Recent achieve- ments in direct growth of high performance III-V quantum dot lasers on Si offer a solution to this problem.		LTh4D.4 • 16:15 An Atom Gyroscope Using a 2D Tilted Magne- to-Optical Trap, Raghav Simha ¹ , Erin Knutson ² , George Welch ³ , Francesco A. Narducci ¹ ; ¹ Naval Air Systems Command, USA; ² Physics, St. Mary's College of Maryland, USA; ³ Physics, Texas A&M Univ., USA. We present atom interferometry measurements using a 2D tilted MOT atom source. The atoms' transit times through mul- tiple continuous Raman beams form the atom optic light pulses. Prospects for a dual sensor will be discussed.	FTh4E.3 • 16:15 Probing the Intrinsic Thermal Noise of Optical Fibers at Infrasonic Frequencies, Lingze Duan'; 'Univ. of Alabama in Huntsville, USA. A Mach- Zehnder-Fabry-Perot-hybrid sensing scheme is proposed for probing the fundamental thermal noise of optical fiber in the infrasonic region. A feasibility analysis is presented and experimen- tal realization is discussed.
FTh4A.4 • 16:30 Angle Resolved Photoelectron Phase Shifts in Above Threshold Ionization, Adi Natan ¹ , Lucas J. Zipp ^{1,2} , Philip H. Bucksbaum ^{1,2} ; ¹ SLAC National Accelerator Lab, USA; ² Physics, Stanford Univ., USA. We observed angle resolved phase shifts from interfering ionization pathways in strong field two-color above threshold ionization spectrum of argon. 2D Phase maps are obtained for both tunneling ionization and multi-photon ionization regimes.		FTh4C.3 • 16:30 Invited Signal Processing using Optical Frequency Combs, Ronald D. Esman', Anthony Lenihan'; 'MITRE Corp, USA. We will review the utiliza- tion of optical frequency combs for wideband signal processing and the impact this will have on microwave systems. We discuss the sub- system performance metrics and relate them to required comb characteristics.	LTh4D.5 • 16:30 WiO Global Discord of Three Quantum Dots in a Driven Cavity with Dissipation in the Steady State, Willa Rawlinson', Reeta Vyas'; 'Univ. of Arkansas, USA. Global Discord is calculated for three identical quantum dots interacting with a quantized cavity field in presence of dissipation, detuning, and driving field in the steady state and correlations with output field behavior is explored.	FTh4E.4 • 16:30 High Resolution All Fiber Optical Coherence Domain Polarimetry, Abdelrahman Afifi', Mahmoud H. Ahmed'; 'Electronics and Commu- nications Eng. Dept., Faculty of Eng., Ain shams Univ., Egypt. An all fiber OCDP is constructed with a fiber loop mirror replacing free space mirrors. The measuring technique incorporates a µs scanning to determine the cross coherence function details at any point in the DUT.
FTh4A.5 • 16:45 Towards Generation of Long and Continu- ous Plasma Channels in Air., Evgeny (Jenya) Papeer ¹ , Moti Botton ¹ , Daniel Gordon ² , Phillip Sprangle ² , Yair Ferber ¹ , Elad Schleifer ¹ , Elior Dekel ¹ , Arie Zigler ¹ , Zohar Henis ¹ ; ¹ Hebrew Univ., Israel; ² NRL, USA. We experimentally demonstrate concatenation of several filaments left in the wake of powerful femtosecond laser. Lifetime of plasma filaments is extended using an external nanoseconds laser thus allowing to generate long, continuous high density plasma channels in air.	Alwyn Seeds holds the Ph.D. and D.Sc. degrees of the University of London. After working as a Staff Member at MIT Lincoln Laboratory he moved to University College London, where he is Professor of Opto-electronics and Head of the Photonics Group. He has published over 400 papers and filed some 20 patents on micro- wave and photonic devices and their systems applications. Professor Seeds has been elected a Fellow of the Royal Academy of Engineering (UK) and an IEEE Fellow (USA). He has served as the Vice-President for Technical Affairs of the IEEE Photonics Society (USA).		LTh4D.6 • 16:45 Magnetic Gradiometer Using Simultaneous Measurements on Two Cold Atom Clouds, Sara DeSavage ¹ , Arvind Srinivasan ² , Danielle Braje ³ , Jon Davis ¹ , Francesco A. Narducci ¹ ; ¹ Naval Air Systems Command, USA; ² Physics, St. Mary's College of Maryland, USA; ³ Integrated Nanosystems, MIT Lincoln Labs, USA. We present measurements of magnetic gradients using atom clouds. Atoms are collected in a 3D MOT and half the atoms are launched. Raman spectroscopy is performed, determining the magnetic field at each atom cloud.	FTh4E.5 • 16:45 Enhancement of Exposed Evanescent Field in a Photonic Crystal Fiber with Triangular Air Holes around the Core for Chemical Sensing, Wee Lit Ng ¹ , Din Chai Tee ¹ , Kwok Shien Yeo ¹ , Ghafour Amouzad Mahdiraji ¹ , Gong-Ru Lin ² , Faisal Rafiq Mahamd Adikan ¹ ; ¹ Univ. of Malaya, Malaysia; ² National Taiwan Univ., Taiwan. Sunny PCF is proposed and numerically investigated. By adding the sunny structure to a normal PCF (air-filling ratio of 0.8), the sensitivity at 1500nm is boosted up from 12.35% to 16.85% without significant confinement loss.

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FTh4F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning II—Continued	FTh4G • Computational Optical Sensing and Imaging III—Continued	LTh4H • Stable Laser Systems—Continued	LTh4I • Novel Laser Systems—Continued	
FTh4F.3 • 16:15 Plasmon-assisted Etching for Fabrication of Planar Opti- cal Components, Qing Ding ¹ , Hao Chen ¹ , Abdul Bhuiya ¹ , Kimani C. Toussaint ¹ ; 'Univ of Illinois at Urbana-Champaign, USA. Plasmon-assisted etching (PAE) of arrays of Au pillar- supported bowtie nanoantenna is demonstrated. As proof-of- concept, we use PAE to demonstrate table-top fabrication of a planar diffraction grating and a Fresnel zone plate.	FTh4D.4 • 16:15 Temporal Ghost Imaging, Piotr Ryczkowski ¹ , Margaux Bar- bier ¹ , Ari T. Friberg ² , John M. Dudley ³ , Goëry Genty ¹ ; ¹ Optics Lab, Tampere Univ. of Technology, Finland; ² Dept. of Physics and Mathematics, Univ. of Eastern Finland, Finland; ³ Institut FEMTO-ST, Université de Franche-Comté, France. We report on the first experimental demonstration of time-domain ghost imaging using a temporally incoherent classical light source. Our results open novel perspectives for dynamic imaging of ultrafast signals with high resolution even in the presence of noise.	LTh4H.4 • 16:15 Simultaneous CW 1063.7 nm and 1070.8 nm dual wave- length Nd:GdVO ₄ laser operation using two VBGs for gain control, Yu-Hua Hsieh ¹ , Ching-Nien Chen ¹ , Te-Yuan Chung ¹ ; ¹ National Central Univ, Taiwan. Dual wavelength operation of a diode pumped Nd:GdVO ₄ laser was constructed using two volume Bragg gratings (VBGs) as the output couplers. By tuning the temperature of both VBGs achieved stabilization dual wavelength laser output.	LTh4I.4 • 16:15 WIO Mode Profile of a Mid-IR Gas-filled Hollow-Core Photonic Crystal Fiber Laser, Neda Dadashzadeh ¹ , Kushan Weeras- inghe ¹ , Andrew Jones ¹ , Benoit Debord ² , Frederic Gerome ² , Fetah Benabid ² , Brian Washburn ¹ , Kristan Corvin ¹ ; 'Kansas State Univ., USA; ² Univ. of Limoges, XLIM Research Inst., France. Beam profile measurements of an acetylene-filled hollow-core fiber laser have been performed for the first time, towards beam combining. The laser produces a beam with M ² of 1.71±0.19.	
FTh4F.4 • 16:30 Vertically Tapered Adiabatic Waveguide Mode Converters Fabricated with Digital Projection Photochemical Etching, Kaiyuan Wang ¹ , Chris Edwards ¹ , Xin Yu ¹ , Lonna Edwards ¹ , Shailendra Srivastava ¹ , Lynford L. Goddard ¹ ; 'Univ of Illinois at Urbana-Champaign, USA. We combine conventional planar semiconductor processing with gray-scale topography cre- ated by digital projection photochemical etching to fabricate adiabatic waveguide mode converters. Applications include efficient coupling to fiber or between planes of multi-layer photonic integrated circuits.	FTh4D.5 • 16:30 Stochastic Characterization of Optical Scattering Poten- tials, Milad Akhlaghi Bouzan ¹ , Aristide Dogariu ¹ ; 'CREOL, College of Optics and Photonics, Univ. of Central Florida, USA. Enhanced fluctuations of integrated scattered inten- sity are used to measure characteristic scales of scattering potentials. The approach relies on controlling only statistical properties of the illumination and is robust against inherent perturbations.	LTh4H.5 • 16:30 WiO Study of White Noise Corner Frequency Location in Re- sidual Phase Noise Measurement with Short and Long Cav- ity Lengths, Kristina Bagnell ¹ , Anthony Klee ¹ , Peter Delfyett ¹ ; 'CREOL - College of Optics and Photonics, USA. We present an investigation of the white noise plateau in residual phase noise measurement of an optical frequency comb for short and long external laser cavity lengths.	LTh4I.5 • 16:30 WiO Two-Photon Spectroscopy in Rb for an Optical Frequency Standard, Gretchen Phelps ¹ , Nathan Lemke ¹ , Chris Erickson ² , John Burke ² ; ¹ Space Dynamics Lab, USA; ² Air Force Research Lab, USA. We report on the development of an atomic clock for both ground and space applications, based upon the two- photon transition in Rb. Off-the-shelf components allow for a simple architecture that supports 7 x 10 ⁻¹³ τ ^{1/2} at 1 second.	
FTh4F.5 • 16:45 WiO Optically Resonant Silver C-shape Arrays Fabricated via Two Photon Photoreduction, Sahar Tabrizi ¹ , Yaoyu Cao ¹ , Benjamin Cumming ¹ , Baohua Jia ¹ , Min Gu ¹ ; 'Swinburne Univ. of technology, Australia. We demonstrate single-step direct laser writing of silver c-shape arrays via highly sensitive two- photon photoreduction process. The periodic nanostructures present strong optical resonances in the near-infrared region. This method provides cost-effective fabrication of functional metamaterial device.	FTh4D.6 • 16:45 Tunable Optical Masks for extended Depth of Field, Jorge Ojeda-Castaneda ¹ , ' <i>Univ. of Guanajuato, Mexico.</i> We discuss the concept of a vortex-pair and its use for implementing phase masks and tunable apodizers, which extend the depth of field. We apply these devices for designing nonconven- tional systems, with zero Petzval sum.	LTh4H.6 • 16:45 Robust Optical Clocks Based on Alkaline-Earth Vapor Cells, Christopher J. Erickson ¹ , Jordan Armstrong ² , Nathan Lemke ³ ; ¹ Space Vehicles, Air Force Research Lab, USA; ² ATA Aerospace, USA; ³ Space Dynamics Lab, USA. Alkaline-earth atoms offer narrow linewidth clock transitions that have been limited to lattice, MOT, and beam geometries due to mate- rial properties. We present compact vapor cell solutions for realizing clocks with these atoms.	LTh4I.6 • 16:45 Thin-Disk Pumped, High-Average-Power, 2.06-µm BiB ₃ O ₆ Femtosecond Optical Parametric Oscillator, Travis Peters- en ^{2,1} , Jake Bromage ¹ ; <i>1Lab for Laser Energetics, USA</i> ; ² Optics, <i>Univ. of Rochester, USA</i> . A sync-pumped optical parametric oscillator using a 48-W, 1.1-ps, thin-disk-based pump laser designed to produce 0.5-µJ, sub-500-fs pulses at 7.08 MHz centered at 2060 nm is currently under construction.	

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FTh4A • Ultrafast Laser Applications II—Continued	FTh4B • Integrated Photonics for Communications: Hybrid Integration on Silicon II— Continued	FTh4C • Symposium on Applications of Low Noise Frequency Combs II—Continued	LTh4D • Complex Dynamcis— Continued	FTh4E • Optical Fiber Sensors IV: Methods—Continued
FTh4A.6 • 17:00 Temporal Lenses for Three-Dimensional Elec- tron Pulse Compression, Liang Jie Wong ^{1,2} , Byron Freelon ² , Timm Rohwer ² , Nuh Gedik ² , Steven Johnson ² , ¹ Sg Inst. of Manufacturing Technol, Singapore; ² MIT, USA. We propose an all-optical method of compressing electron pulses to attosecond durations and sub-microm- eter dimensions using ultrafast optical pulses. Applications range from ultrafast electron imag- ing to coherent terahertz sources.	FTh4B.4 • 17:00 WiO Selective growth and coalescence of GaAs on Si (001) substrates using a round-hole nanopatterned SiO ₂ mask, Yunrui He ¹ , Jun Wang ¹ , Haiyang Hu ¹ , Qi Wang ¹ , Yongqing Huang ¹ , Xiaomin Ren ¹ ; 'BUPT, China. The epitaxy of GaAs on round-hole nanopat- terned GaAs/Si substrates is studied. Faceted growth fronts and the tilt of GaAs pillars are observed. Experimental results show that the deposition selectivity is not sensitive to growth temperature.	FTh4C.4 • 17:00 Invited C Comb-locked Arbitrary Signal Synthesis, Radan Slavik ¹ , David S. Wu ² , David J. Richard- son ¹ ; ¹ Univ. of Southampton, UK; ² Albert Einstein Inst., Max Planck, Germany. New route toward optical waveform generation based upon the coherent combination of multiple comb-locked semiconductor lasers operating at different wavelengths is investigated. Various challenges associated with this approach are addressed.	LTh4D.7 • 17:00 Realization of Inverse Saturable Absorp- tion by Cascaded Second-Order Process for Stable Modelocking, Shyamal Mondal ¹ , Shouvik Mukherjee ^{2,1} , Satya P. Singh ¹ , Prasanta K. Datta ¹ ; ¹ Indian Inst. of Technology Kharagpur, India; ² Dept. of Physics and Astronomy, Univ. of Pittsburgh, USA. Experimentally realized stable picosecond pulses from a cascaded second- order cw-mode-locked Nd ¹ :YVO ₄ laser has been verified by a self-consistent-complex-beam propagation method with radially varying gain aperturing which accounts the stable pulsewidth	FTh4E.6 • 17:00 Invited Fibre Optic Radiation Sensor Systems for Particle Accelerators, Jochen Kuhnhenn'; 'Fraunhofer-Institut Naturwissenschaftlich Tech- nische Trendanalysen, Germany. Sensing radia- tion with optical fibers has become a valuable tool especially at accelerators over the last de- cade. This presentation will present principles, constraints and options to detect radiation via different effects induced in optical fibers.
FTh4A.7• 17:15 Development of Predictive Models of Absorp- tion of High Power Laser Light by Optically- Thick Materials, Matthew Levy ¹ , Scott C. Wilks ² , Max Tabak ² , Stephen Libby ² , Siegfried Glenzer ³ , Peter Norreys ¹ ; ¹ Univ. of Oxford, UK; ² Lawrence Livermore National Lab, USA; ³ SLAC National Accelerator Lab, USA. Key metrics for petawatt (10 ¹⁵ W) laser applications, such laser fusion, relate to the absorption f. In this paper, we show how to derive the theoretical extrema of f. We then show how to sweep out curves through this constrained parameter space.	FTh4B.5 • 17:15 Silicon-Integrated Graphene-Based THz Modulator, Martin Mittendorff ¹ , Shanshan Li ² , Thomas E. Murphy ^{1,2} , ¹ Inst. for Research in Electronics & Applied Physics, Univ. of Maryland, USA, ² Dept. of Electrical & Computer Engineer- ing, Univ. of Maryland, USA. We present a broadband THz modulator based on a silicon waveguide with a graphene sheet on top. The Fermi energy, and therefore the intraband absorption in the graphene, is modulated via a back gate.		and inverse saturation loss behavior.	
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FTh4F • Three-Dimensional Optical Structure Design, Fabrication and Nanopatterning II—Continued	FTh4G • Computational Optical Sensing and Imaging III—Continued	LTh4H • Stable Laser Systems—Continued	LTh4I • Novel Laser Systems—Continued	
FTh4F.6 • 17:00 Designing All-Dielectric Structures for Efficient Directional Scattering, Roxana Rezvani Naraghi ^{1,2} , Sergey Sukhov ¹ , Aristide Dogariu ¹ ; ¹ CREOL, The College of Optics and Pho- tonics, Univ. of Central Florida, USA; ² Dept. of Physics, Univ. of Central Florida, USA. By structural design of wavelength- size all-dielectric spherical particles, one could control the scattering directivity. Besides, an inverse Mie procedure can be implemented for core-shells particle in order to find the refractive indices and particle size.	FTh4D.7 • 17:00 WiO Sampling Rate Chosen to Ensure Unitary and Additive Properties for the 2D Non-separable Linear Canonical Transform, Liang Zhao ¹ , Inbarasan Muniraj ¹ , John J. Healy ¹ , John T. Sheridan ¹ ; ¹ Univ. College Dublin, Ireland. The linear canonical transform can model a wide variety of paraxial opti- cal systems. The continuous transform is additive & unitary, sampling rate chosen to ensure these two important group properties during discretization are summarized.	LTh4H.7 • 17:00 Multi-Pulsing Dynamics in Coupled-Cavity Soliton Fiber Laser, Ki Sang Lee ¹ , Kee Hwan Nam ¹ , Myeongsoo Kang ¹ ; ¹ Dept. of Physics, KAIST, Korea. Dynamics of a coupled-cavity mode-locked soliton fiber laser is experimentally investigated at both the single-pulsing and multi-pulsing regimes. In particular, multi-pulsing dynamics can be widely controlled by tuning the cavity coupling strength and intra-cavity loss.	LTh41.7 • 17:00 Linearly Tunable Single Frequency Nd: YVO ₄ Laser Utilizing RTP as Electro-Optical Element, Xinrui Xu ¹ , Deying Chen ¹ , Rongwei Fan ¹ , Yufei Ma ¹ , Renpeng Yan ¹ , Xudong Li ¹ ; 'Na- tional Key Lab of Science and Technology on Tunable Laser, Harbin Inst. of Technology, China. A linearly tunable single frequency Nd: YVO ₄ laser is proposed. Single frequency tuning operation with a tuning range of 6.9 GHz at 1064 nm is achieved by tilting etalon and modulating voltage applied on RTP simultaneously.	
FTh4F.7 • 17:15 Designing Transparent Structural Color, Chia Wei Hsu ^{1,2} , Owen D. Miller ² , Steven Johnson ² , Marin Soljacic ² ; ¹ Yale Univ., USA; ² MIT, USA. We design dielectric stacked-ring structures that are transparent under omnidirectional broadband illu- mination but scatter strongly with a directional narrowband light source. Such structures can be used as transparent projection screens.	FTh4D.8 • 17:15 Trans-spectral Ghost Microscopy, Reuben Aspden ¹ , Nathan R. Gemmell ¹ , Peter Morris ¹ , Daniel S. Tasca ² , Lena Mertens ¹ , Michael G. Tanner ³ , Robert A. Kirkwood ¹ , Alessandro Rug- geri ⁴ , Alberto Tosi ⁴ , Robert W. Boyd ^{5,6} , Gerald S. Buller ³ , Robert H. Hadfield ¹ , Miles J. Padgett ¹ , ¹ Unix of Glasgow, UK; ² Universidade Federal do Rio de Janeiro, Brazil; ³ Heriot-Watt Unix., UK; ⁴ Informazione e Bioingegneria Politecnico di Mila- no,, Italy; ⁵ Unix of Rochester, USA; ⁶ Unix of Ottawa, Canada. Low-light infrared imaging techniques suffer from high noise levels and cost. We demonstrate a ghost microscopy system where the object is probed using infrared photons whilst the image is developed with correlated visible photons.		LTh41.8 • 17:15 Graphene/Polymer Composite Saturable Absorbers Based On Evanescent Wave Interaction Using Etched Fiber, Hyub Lee', Won Sik Kwon', Jin Hwan Kim', Daewon Kang', Kyung- soo Kim', Soohyun kim'; 'Korea Advanced Inst. of Science and Technology , Korea. A graphene/polymer composite coated on a chemically etched fiber is used as a saturable absorber based on evanescent wave interaction for passive mode-locking of ultrafast fiber lasers.	